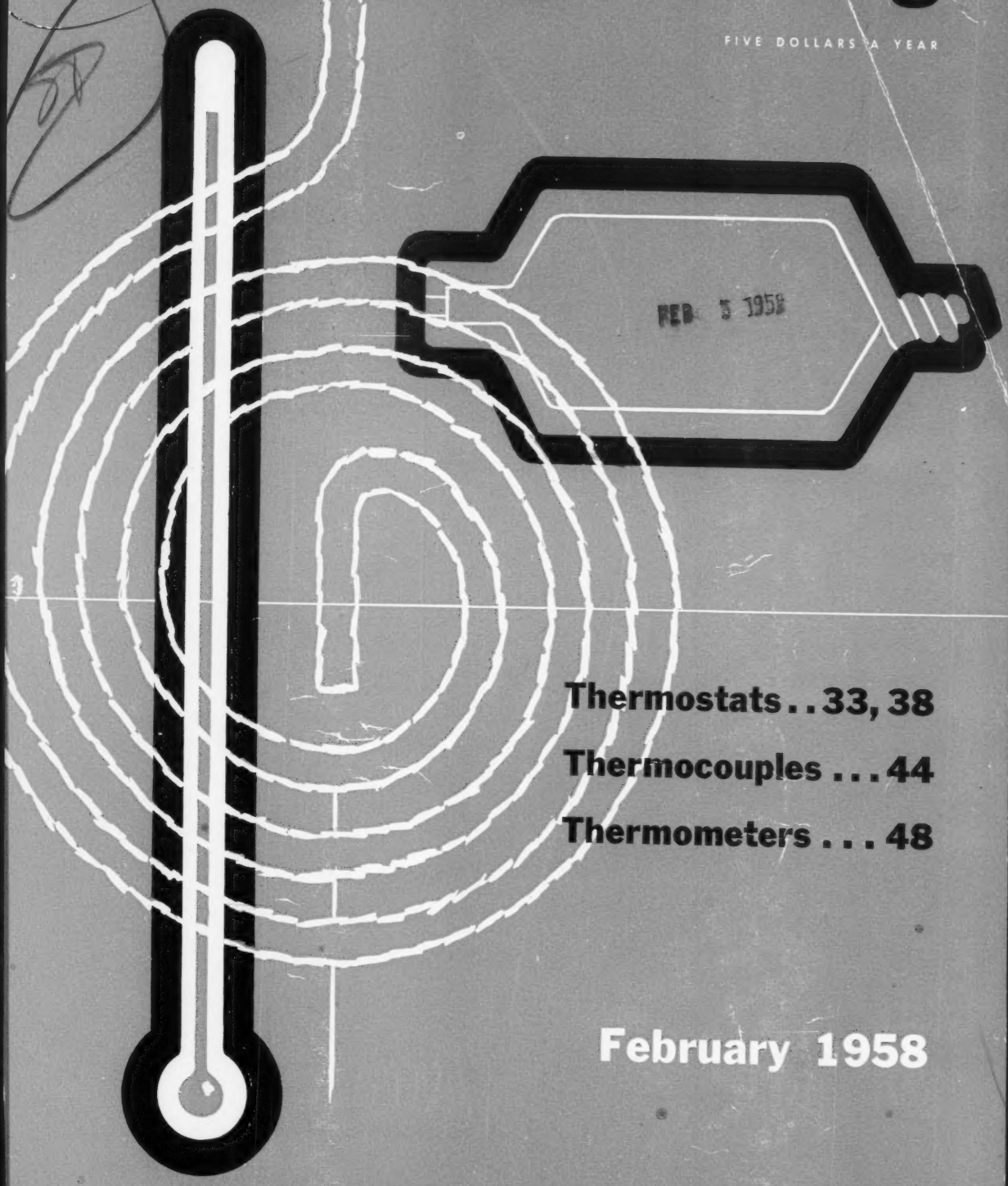
Design Engineering

FIVE DOLLARS A YEAR

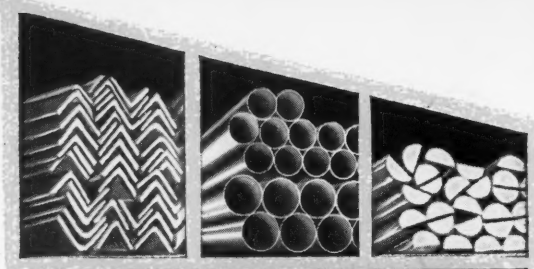


FEB 5 1958

February 1958

PUBLISHED BY THE MACLEAN-HUNTER PUBLISHING COMPANY LIMITED, TORONTO, CANADA

THEY KNOW



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These distributors are also your consultants on all aspects of aluminum — its uses, properties and alloys.

ALCAN DISTRIBUTORS participate in Alcan training courses and are qualified to answer your questions about this modern metal. They are backed by ALCAN's specialized knowledge and experience.

ALCAN

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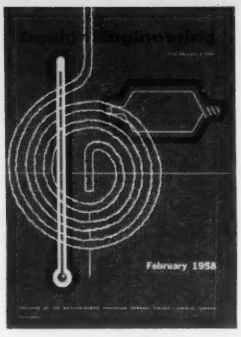

Design Engineering

VOL. 4 FEBRUARY 1958 No. 2

This month's cover

Second contribution to the covers of Design Engineering from the Vivash-Smith Studio is our February one which represents the "thermo's" (thermometers, thermocouples and thermostats) to which the issue is largely given over. Astute readers will be able to match each cover symbol with its appropriate "thermo." The chosen red aids the heat theme of the articles throughout the book.

Design Engineering

MEMBER

CCAB

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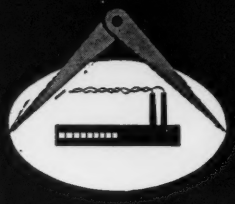
DU PONT ELASTOMERS

NEOPRENE • HYPALON®



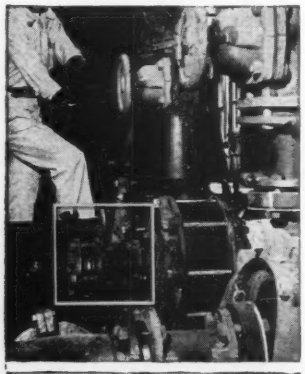
in Industry

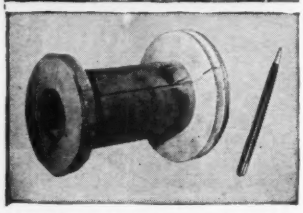
NEOPRENE connectors save $1,000 a year in hydrochloric acid area

At a large midwestern chemical plant, long-lasting neoprene connectors have replaced the original fittings used to connect Karbate pumps to suction and discharge lines. This switch represents a saving in materials and labor of $1,000 a year.

Although the previous materials used were chemically suitable to handle hydrochloric acid, they were rigid, and pump vibrations cracked them. Resilient neoprene connectors are unimpaired by exposure to hydrochloric acid and they are flexible enough to resist vibration to compensate for shifting lines without being damaged.

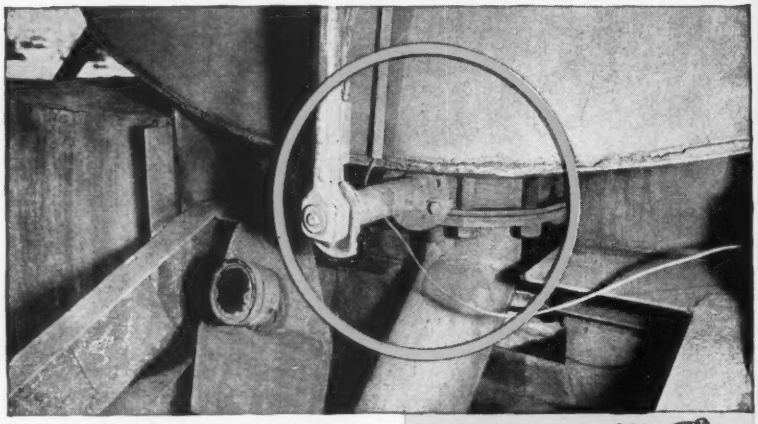
Neoprene resists oil, grease, heat, weather and chemicals and operates successfully under many of the industry's toughest exposure conditions. Mail the coupon for more information. Include your specific problems.



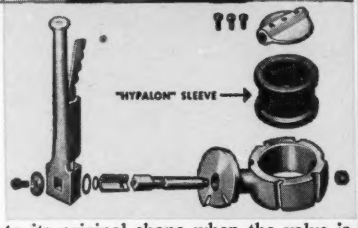


Flexible neoprene connectors resist hydrochloric acid, allow for misalignment between pumps and suction and discharge lines.

HYPALON® eliminates sleeve maintenance costs in butterfly valve handling spent acids



The resilient HYPALON sleeve in this butterfly valve snaps into the ring piece. It acts as both a valve seat and as the gasket between the ring piece and mounting flanges, giving a perfect seal.



ORIGINAL VALVES STILL ON DUTY AFTER TWO YEARS' SERVICE

Industrial Wastes, Inc., of Beaver Falls, Pa., hauls about 2½ million gallons of spent acids each month in its fleet of tank trucks. About two years ago, the company faced the problem of finding an all-purpose tank outlet valve which would give longer service.

They tried a butterfly valve with a sleeve of HYPALON. Here's how it works: An acid-resistant metal damper rotates in a ring piece lined with a HYPALON sleeve. As the valve closes, the metal disk distorts the resilient HYPALON sleeve to form a pressure-tight seal. The sleeve returns to its original shape when the valve is opened.

The resistance of HYPALON to sulfuric, nitric, hydrochloric and hydrofluoric acids has kept the valve in operation for *two years*—with a minimum of maintenance. Can HYPALON help you? This versatile synthetic rubber also has unusual resistance to hardening at elevated temperatures (250° to 350°F.)... is virtually ozone-proof . . . and can be fabricated into hose, gaskets, belts, linings or prepared as solution coatings. For more information, clip and mail coupon.

DU PONT CANADA

HYPALON *is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.)*

MAIL THIS COUPON TODAY!

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Design Engineering

Inside

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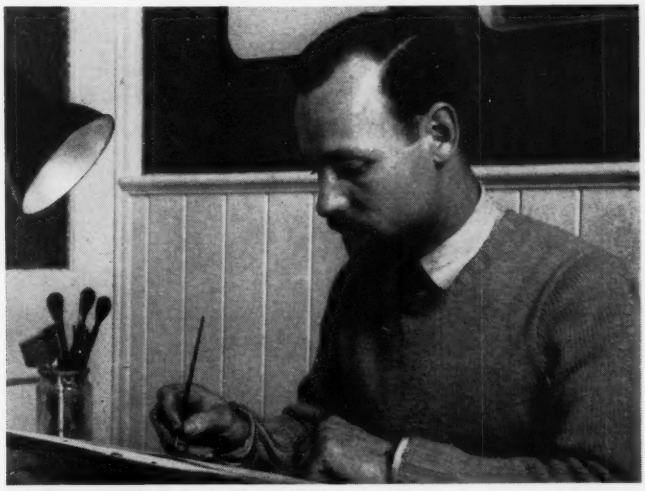
DAHLEN

Paul Dahlen (Each thermostat does only one job well) is an ex-Iowa State College man who graduated from there in 1948 with a BSc in mechanical engineering. Dahlen joined the Hoover Co. on graduation and was with the company as a design engineer until 1952 when he took a position as application engineer with Stevens Mfg. Co.

* * *

Responsibility for the neat and orderly layout of Design Engineering's editorial pages rests in the hands of the bearded gentleman seen wielding a brush in the picture below. Leslie A. Smart, commonly known as Sam, has been in Canada since 1954 and came here from the Portsmouth College of Arts. A married man with two children, he lives up on Lake Simcoe and commutes the forty miles between his home and his office twice a day. A member of numerous graphic arts societies, he is president of the Society of Typographic Designers in Canada and Fellow of the Royal Society of Arts.

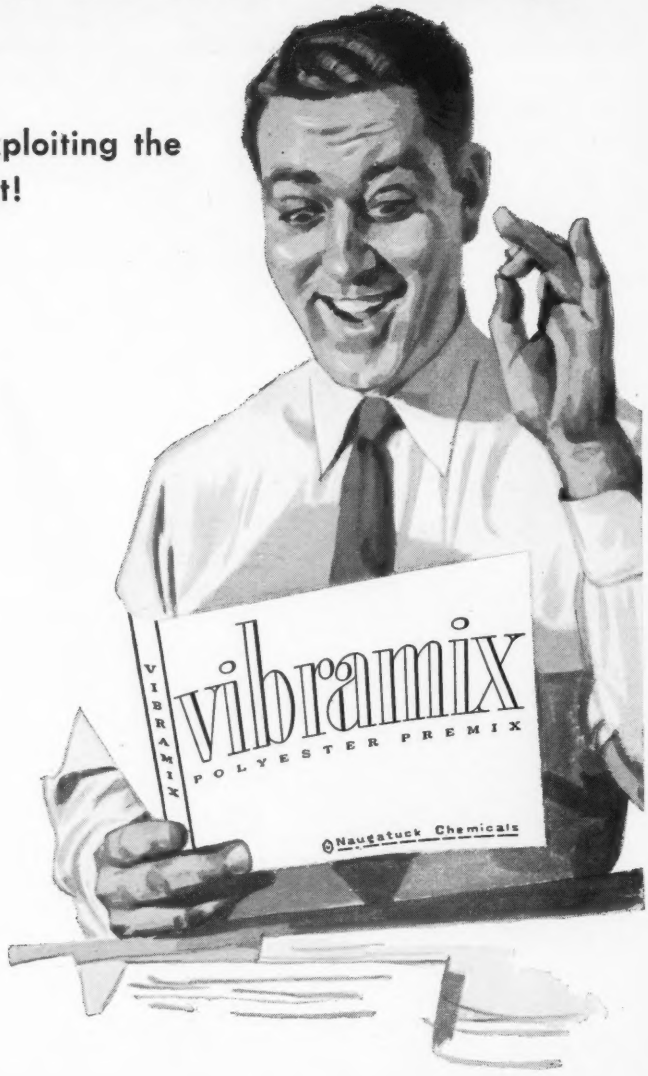


SMART

vibramix

Raw Material for Strokes of Genius

Genius is often a case of exploiting the practical... and doing it first!



And VIBRAMIX offers you one of your best opportunities yet. A family of polyester premix molding compounds, VIBRAMIX opens endless avenues to product improvement and cost reduction. Here are the reasons:

VIBRAMIX is a premixed compound of Vibrin and reinforcing material — glass, sisal, asbestos or others, plus filler and colour as required.

VIBRAMIX is easily formed by compression or transfer molding at medium pressures and heats.

VIBRAMIX may improve products by replacing other plastics, metals, wood and ceramics.

VIBRAMIX simplifies assemblies and eliminates many finishing operations.

Please Weigh These Special Features:

Good heat stability • Good dimensional stability • Excellent electrical properties • Excellent flow properties • Elimination of glass preforming, resin mixing, preheating and curing • Short molding cycles • Use of standard compression and transfer molding machines and techniques.

Molding Principles

Mold Temperature: 290° – 300°F.
Mold Pressure: 1000 – 2000 p.s.i.

YOU ARE INVITED TO WRITE OR PHONE TODAY for the new VIBRAMIX BROCHURE, giving complete technical data on various types of VIBRAMIX and recommended applications.

other NAUGATUCK plastics

Vibrin–Polyester Resins • **Marvinol**–Vinyl Resins
Kralastic–Styrene Copolymers

Naugatuck Chemicals

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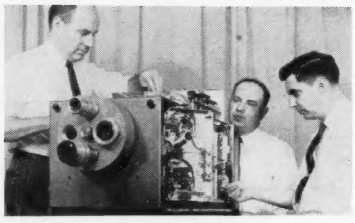
Reports

A news roundup of items of engineering and design interest from the world over

Now they've put the squeezedown on TV cameras



Late in November, General Electric took the wraps off a new color TV camera for which they claim reduced size, simpler design and easier operation. It incorporates printed circuits and transistors. Under development for more than a year, the camera has sweated off enough excess weight to make it 75 lb. lighter than current models and the newly developed optical system has eliminated the need for many glass surfaces through which the color signals were previously required to pass.

The weight and size reduction is expected to prove a boon to cameramen, especially in shots requiring downward panorama takes.

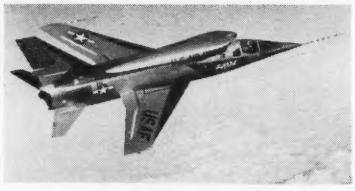
Chance for your muffler to live to be four

The Bettinger Corp., which hails from Massachusetts, has specialized in the ceramic coating of metals for some while. In the view of President Weaver the company may be on the doorstep of a new line of business.

Says Weaver, "Ceramic coatings for auto mufflers are planned for introduction soon. Since we started coating truck mufflers (and boosted their life to over four years) leaders in the automobile muffler field have approached us to adapt our technology to their product."

If Bettinger Corp. is successful and can produce a ceramic-coated muffler at a competitive price, they have the medicine for a headache that plagues the motorist all too frequently.

Plane that exceeds Mach 1 in vertical climb



North American Aviation's F-107, which flies in the region of Mach 2 in both level and climbing flight, carries an overhead duct (see pic) to give maximum efficiency to the J-75 jet engine.

The spoiler system of hinged doors on both upper and lower wing skins operate to aerodynamically control air passage over and under the wings during high speed manoeuvring and this lateral control method (instead of using conventional ailerons) is considered a major advancement in high-speed flight.

Power steering for the ploughman

First shown at the Smithfield Show in England, the new Massey-Ferguson 65 tractor comes decked out in power steering, differential lock and disc brakes.

Using a 4-cylinder Continental as power plant, the 65 will have an estimated belt hp of 48 and 42 hp at the drawbar. The brakes are located on the rear axle, adjacent to the differential assembly. They are double disc type (7 in.) and have a planetary reduction at the wheel mountings.

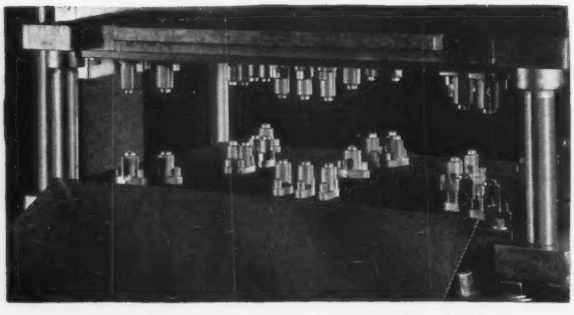
Also new out of M-H-F is the Massey-Harris "35 combine" which has been designed with the family sized farm in view. Of small over-all dimensions and light in weight, the 35 is agile enough to be driven from field to field or farm to farm without removing the table which comes in a 7 or 8-ft. width.

Maximum freedom of design with versatile STRIPPIT *tooling!*

You can design any pattern of round, square, obround or special-shape holes — plus any type of notching — in flats, structurals or extrusions — and know that production can handle it with swift economy using STRIPPIT tooling, either on pilot or production runs!

Strippit self-contained, self-stripping punching and notching units can be set up in any template pattern within press capacity — placed in the press for any length of run with little down-time — quickly set up in new patterns. Other Strippit cost-cutting advantages include:

• The effect of quick-change dies without die-making or die-spotting • Speed over drilling — plus no deburring • Units re-usable over and over • Readily removable punches and dies • Ease, accuracy of template mounting — pilot pin centered on punch • Each unit complete — permanently aligned, fully guided, self-stripping.



For unlimited feeding of work, Strippit Type CD and JD (heavy-duty) Punch and Die Assemblies are readily template-mounted to press ram and bed in any desired pattern.

Write today for all details and a demonstration by a Strippit mobile unit at your plant.

Special tools made up to your specifications.

One of a complete line of Strippit vertical and horizontal hole punching units in capacities from the lightest material to ¾" mild steel. Wide choice of die heights, shut heights and throat depths.

Also, 90-degree Corner Notching Units in 3" x 3" and 5" x 5" sizes, plus V, Radii and many special shape notching units. Capacities to ⅛" in mild steel.

STRIPPIT

TOOL & MACHINE LIMITED

Formerly Wales Strippit of Canada, Ltd.

103 Research Rd., P. O. Box 688, Brampton, Ontario

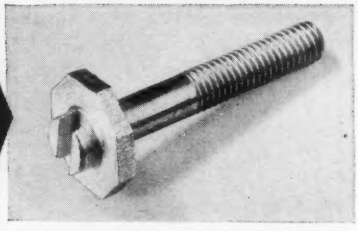
A UNIT OF HOUDAILLE INDUSTRIES INC

Two (or more) for the price of one!

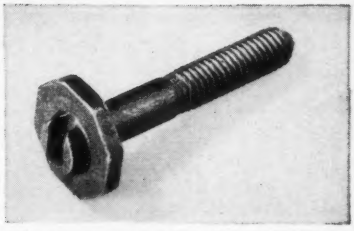
Here's PROOF of savings...

by STELCO COLD HEADING

Manufacturer 'A' saves 50% (approx.) on overall cost

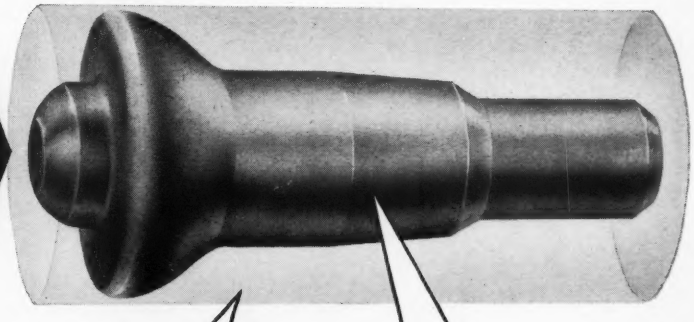


Enlarged view of part previously produced by machining.



Part as now produced by STELCO Cold Heading at half the cost.

Manufacturer 'B' uses 63.5% less material



Material blank previously used for machining (actual length 2¼") .550 lbs.

Finished part, cold headed by STELCO. Material used .200 lbs.

Any part that can be machined from rod stock is potentially suited to production by cold heading. This technique offers speed of production* without scrap loss — and therefore low unit costs. Costs remain attractively low even when one or more secondary operations is required. In addition, cold working increases the tensile strength of the metal, and produces an excellent surface finish.

Quality of cold headed products is high, because metals must be resistant to cracking and free from defects to be satisfactorily upset or extruded cold.

Stelco's Engineers can tell you quickly whether *your* fasteners or contoured parts can be made by cold heading. If so, the savings are likely to be considerable. Send in your specifications with a drawing and an idea of the application, and you will receive prompt attention.

Any Stelco Sales Office is at your service.

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J. C. Pratt & Co. Limited, St. John's, Newfoundland

**In one recent instance speed of production was increased from 30 per hour to 6000 per hour by converting from automatic screw machine production to cold heading.*

57122.B

Quality

If forgings are a component,
your product can be better, stronger, safer because of
the big extras in Dominion's forgings

Lower manufacturing costs, a superior product, little if any need for field service and repairs are what you expect—and *get*—when one or more of your product's components are forged.

Something else on which you can count is a better, stronger, safer product if your forgings are from Dominion Forge Limited, one of North America's great forges.

While Dominion's forging and auxiliary facilities cannot be matched for versatility by any other commercial forge on the continent, that's simply a guarantee of service. Dominion's insistence on a standard of quality unsurpassed in its industry is what assures a consistency of quality that is equally unsurpassed. It's a big *extra*. A big extra that adds up to a better, stronger, safer product. *A big extra that costs you nothing extra!*

Your Dominion Forge *forging engineer's* first responsibility is to help you get *all* the extras in forgings Dominion delivers. Put his training and experience to work for you. You'll find it pays.

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MEMBER: DROP FORGING ASSOCIATION

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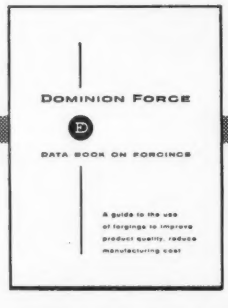
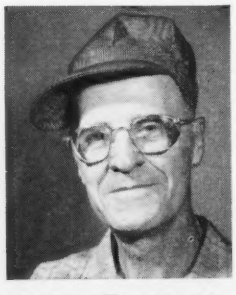


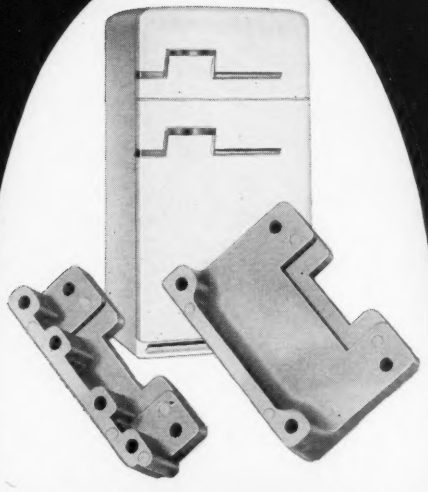
FREE! Handy informative guide that ought to be at your elbow. Dominion Forge's **DATA BOOK ON FORGINGS,** packed with useful facts, illustrates and describes Dominion's unique facilities. Write for your free copy. No obligation, of course.



DIE SINKER Ernie Berthiaume is one of over 125 members of Dominion Forge's Quarter Century Club—an aggregation of forging experience on which you can count.

LOWER MANUFACTURING COSTS

...with molded reinforced polyester



SIMPLER ASSEMBLY

FOR Servel

Bracket and support for refrigerator liner and evaporator, molded of ATLAC Thermaflow compound, replace (1) multiple-piece assembly of steel part, spacer and fasteners and (2) machined piece of laminate. Gave superior thermal insulation, better shock resistance, simplified manufacture. Molded for Servel, Inc. by Kurz-Kasch, Inc., Dayton, Ohio.

Assembly time is cut to the bone and machining is eliminated when you design with ATLAC Thermaflow molding compounds in mind. Complex multi-piece assemblies can often be molded in one rigid piece, complete with molded-in bushings and fittings. Machining is made unnecessary by precision molding techniques and excellent surface finish. Surfaces need no painting—the part is corrosion resistant and available in colors.

In addition, ATLAC Thermaflow materials offer;

- **Weight savings: specific gravity 1.8**
- **High impact and flexural strength**
- **Superior corrosion resistance**
- **Excellent electrical insulation and arc tracking resistance**

To the molder—

ATLAC Thermaflow materials are easy to mold in large shapes, with deep draw and intricate detail. Reinforcement flows evenly throughout the piece . . . no weak spots at corners or edges. Compression or transfer mold them on standard presses, at temperatures from 275-350°F., and pressures from 500 psi and up. Curing time is relatively short.

A wide range of glass fiber and nylon rag reinforced grades is available. Write today for literature on materials, molding recommendations and applications.

Atlac THERMAFLOW—Trademark, Atlas Powder Company

ATLAC THERMAFLOW

ATLAS

ATLAS POWDER COMPANY, CANADA, LTD.
Brantford, Canada
***Offices in* MONTREAL, TORONTO, EDMONTON, VANCOUVER**

New chain has steel's strength plus nylon's wear resistance

NY-STEEL FLAT TOP CHAIN on Horix Fitting Machine with nine fitter valves. This unit is in service at Mangels Herold Company, manufacturers of King Liquid Laundry Starch.

Link-Belt Ny-Steel flat-top chain fits existing sprockets

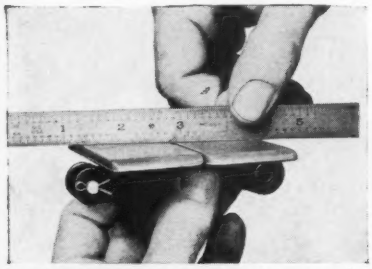
Nylon and Steel — Link-Belt combines both in Ny-Steel Flat-Top Roller Chain. This combination gives you a smooth, resilient nylon carrying surface to reduce glass breakage and track wear — plus a precision steel roller chain with the strength and durability to carry heavy loads without stretching. Ny-Steel is less than half the weight of similar all-steel chain — has proven itself ideal for safe, low-cost conveying of bottles, cans and similar items.

Exceptional wear-life

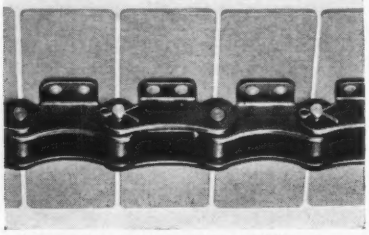
Long life is one of Ny-Steel's many outstanding features. It resists chemicals and corrosion . . . retains pitch, even under moisture conditions . . . gives long-lasting service with practically no top-plate or track wear.

Ny-Steel is easy to install . . . fits existing sprockets. And for new installations or replacements, Link-Belt makes a full line of cut-tooth sprockets. Ny-Steel comes with top plates assembled on either stainless or heat-treated carbon steel chain.

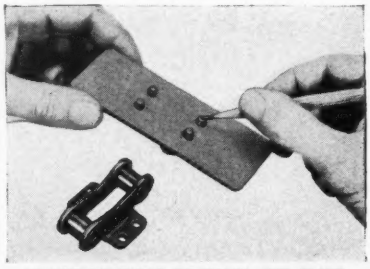
Why Ny-Steel is industry's most advanced flat-top conveyor chain



RIVET-FREE SURFACE — Top plates are of uniform thickness, without rivet pockets or projections. Each is chamfered and mounted level with adjacent plates.



PRECISION STEEL ROLLER CHAIN gives Ny-Steel its great strength . . . facilitates installations and maintenance. Can be easily coupled or uncoupled.



SECURE BONDING OF CHAIN AND PLATE — Underside of each plate is molded with projections that become self-rivets. This leaves surface free of obstructions.

The large picture above illustrates one of many applications of Ny-Steel flat-top chain. Besides being smooth, nylon plates are shock-absorbent . . . assure safe, easy transfer of containers.

Ny-Steel top plates are available in 3¼ and 4½-in. widths. Folder 2492 contains complete dimensions and specifications.

HEADQUARTERS FOR CHAINS, SPROCKETS is your nearby Link-Belt factory branch store or authorized stock-carrying distributor. Write for Catalog 900.

LINK-BELT

CHAINS AND SPROCKETS

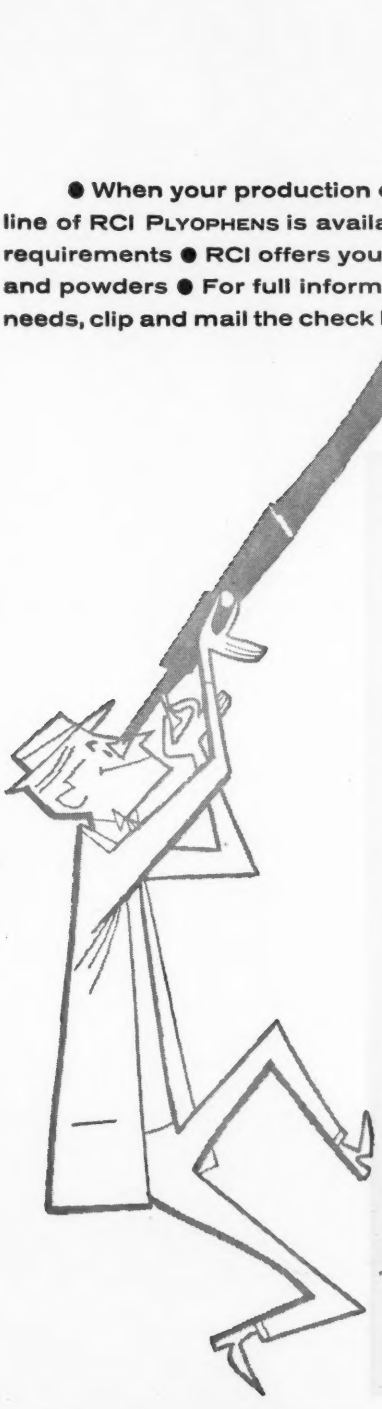
LINK-BELT LIMITED: Scarboro Plant, General Offices and District Sales—Scarboro, Ont., Station H, Toronto 13 • Eastern Avenue Plant and Factory Branch Store—Toronto 8 • Sales Offices and Factory Branch Stores —Montreal 15 • Vancouver 12 • Winnipeg 10 • Swastika, Ont. • Halifax: Austen Bros. Ltd. • District Sales Offices—Hamilton • Sydney: Austen Bros. Ltd. • Foundry at Elmira, Ont. 14.743-C

TAKE A CLOSE LOOK AT THE FULL LINE OF RCI

PLYOPHEN

PHENOLIC RESINS

● When your production calls for phenolics, be sure you call Reichhold—where a full line of RCI PLYOPHENS is available for your bonding, laminating, impregnating or casting requirements ● RCI offers you more than 40 individual PLYOPHENS—including both liquids and powders ● For full information on how RCI PLYOPHENS can best serve your individual needs, clip and mail the check list below. Technical information will be sent to you promptly.



My Name is_____

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of the company indicated on this letterhead.

Please send me full technical information on the use of RCI PLYOPHEN Phenolic Resins for:

- ☐ Brake Linings
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- ☐ Casting
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- ☐ Gear Stock
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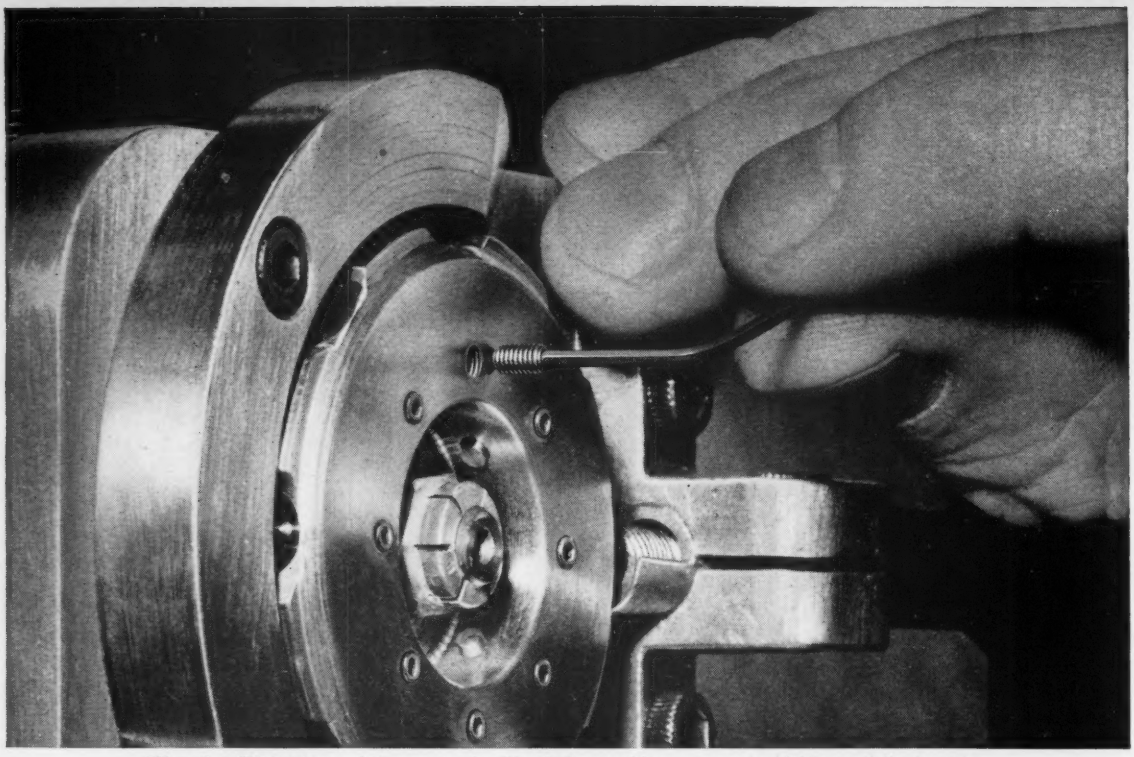


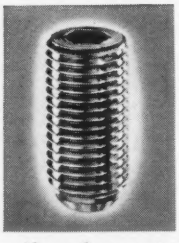
Microsize UNBRAKO socket screws simplify design problems—even in highly specialized equipment like this prototype precision loading device for use in advanced automated production operations.

Miniaturize with UNBRAKO set screws

HEAT-TREATED ALLOY STEEL
PLAIN CUP POINT
Class 3 Fit Standard

Diameter		Threads per inch NC	Threads per inch NF	L Overall Length	Recommended Installation Torque in Inch-Pounds NC	Recommended Installation Torque in Inch-Pounds NF	Weight per Box of 100 in Pounds
#0	D .060 F .028	..	80	1/16	..	.5	.01
		..	80	3/32	..	.5	.01
		..	80	1/8	..	.5	.01
		..	80	5/32	..	.5	.01
		..	80	3/16	..	.5	.01
		..	80	1/4	..	.5	.01
#1	D .073 F .035	..	72	1/16	..	1.5	.02
		..	72	3/32	..	1.5	.02
		..	72	1/8	..	1.5	.02
		..	72	5/32	..	1.5	.02
		..	72	3/16	..	1.5	.02
		..	72	1/4	..	1.5	.02
#2	D .086 F .035	56	..	1/16	1.5	..	.03
		56	..	3/32	1.5	..	.03
		56	..	1/8	1.5	..	.03
		56	..	5/32	1.5	..	.03
		56	..	3/16	1.5	..	.03
		56	..	1/4	1.5	..	.03
#3	D .099 F .050	48	..	3/32	5.0	..	.04
		48	..	1/8	5.0	..	.04
		48	..	5/32	5.0	..	.04
		48	..	3/16	5.0	..	.04
		48	..	1/4	5.0	..	.04

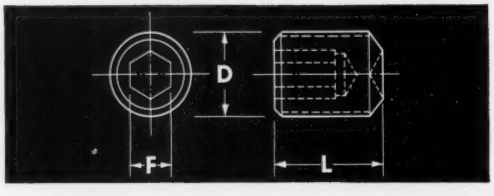
*Also available in stainless steel



You need not design special set screws to secure your new miniaturized equipment. Microsize UNBRAKOS were developed specifically for use in modern small devices.

UNBRAKO screws are made of carefully selected alloy steel. They are manufactured to timepiece precision. Sockets are deep and uniform for greatest wrench engagement and longest reuse. Threads are fully formed for maximum strength and exact fit. And UNBRAKOS are heat treated to the optimum condition for high tensile strength and ductility without brittleness or decarburization.

Ask your authorized industrial distributor about microsize UNBRAKO socket screws today. Or write us for Bulletin 1001 and samples.



UNBRAKO®

STANDCO CANADA, LTD.
193 Bartley Drive
Toronto 16, Ontario

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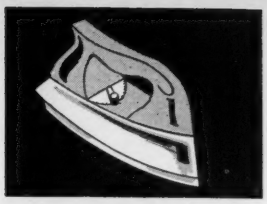
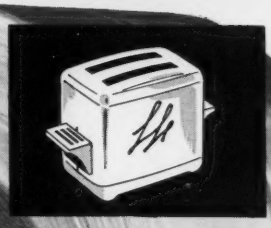
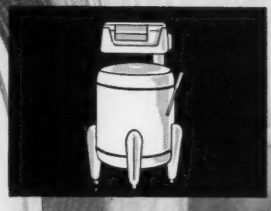
product to demand

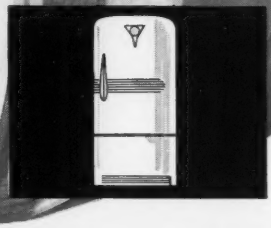
HIGH QUALITY HOT OR COLD ROLLED SHEETS AND STRIP

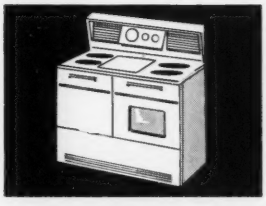
made and processed to proper
specifications to meet your
exact manufacturing requirements

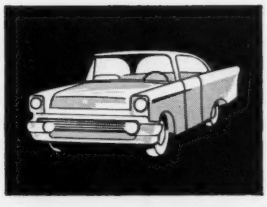












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—in carbon and alloy grades—in cut lengths or coils—

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- Hot Rolled Sheets and Strip—mill or slit edge —black or pickled and oiled
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- Cold Rolled Electrical steel in Field, Armature, Electrical and Motor grades

ALGOMA

ALGOMA STEEL

CORPORATION, LIMITED

Sault Ste. Marie, Ontario

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THE LYMAN LINE OF LEADERS

Providing a wide latitude in design

LYMAN JOHNSON Bearings

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ROLLED BRONZE

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CAST ALUMINUM ALLOY

GRAPHITED BRONZE

LEDALOYL SELF-LUBRICATING

POWDERED IRON ALLOY

To attain the most economical and efficient bearings, many engineers take advantage of the wide variety of Johnson sleeve bearings listed on this page.

They find that sleeve bearings take up less room than other types of bearings—give long service life—provide maximum shaft protection in almost any type of equipment. In fact, the applications of Johnson Bearings are so wide that it is impossible to even list them here.

DESIGN ASSISTANCE AVAILABLE

When designing equipment it pays to provide for the use of standard bearings wherever possible. They cost less than custom bearings and are readily available from stocks maintained in Lyman warehouses at Montreal, Toronto and Winnipeg.

The selection of the proper type, size, and alloy is important if you wish to get the greatest value consistent with good performance. If you have any doubt about selecting the proper bearing, Lyman engineers will be glad to assist, since Johnson produces all types of sleeve bearings. For advice on any specific problem, send us a sketch and estimate of the working speeds, loads, temperatures and possible method of lubricating your equipment. We will send you a recommendation without delay.

LYMAN TUBE AND BEARINGS, LIMITED

MONTREAL TORONTO HAMILTON LONDON WINNIPEG
VANCOUVER NEW GLASGOW, N.S.

ONE QUICK LOOK TELLS YOU WHY THE BELLOWS AIR MOTOR MEETS ORIGINAL EQUIPMENT DESIGN NEEDS SO PERFECTLY

As you can see, it takes but little more space, built-in valving and all, than a conventional air cylinder alone, without valve. Its single air connection (which can be inexpensive and easily installed flexible hose) makes it simple to install on moving machine elements. Its low voltage (8-12 v.) electrically controlled valve permits less costly wiring, simpler hook-up, and easy interlock with related movements.

1013-B

The Place of the Bellows Air Motor in Original Equipment Design is the subject of a 16-page bulletin. We'll be happy to send you a copy without cost or obligation. Write Dept. DE-258, The Bellows Co., Akron 9, Ohio. In Canada: The Bellows Pneumatic Devices of Canada, Ltd., Toronto 18.

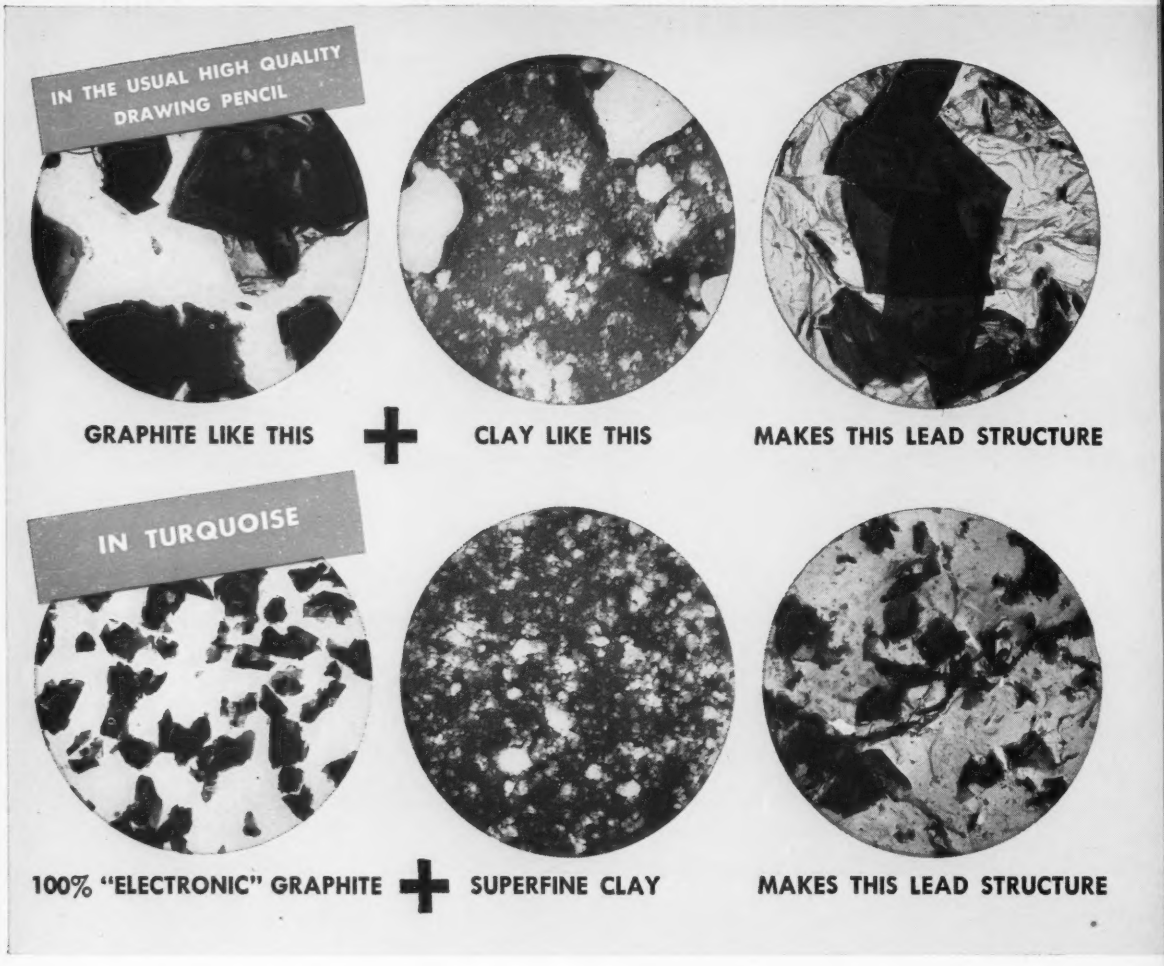
What you can't see in the picture is equally important. With the Bellows Air Motor comes the skill and service facilities of more than 125 full time Bellows Field Engineers—men as near you as your phone. They will work with you in applying Bellows "Controlled-air-power" to your designs and they're available quickly to meet any service need.

In your OEM planning take advantage of the savings "Controlled-air-power" offers—and as most manufacturers do—talk to Bellows.

Bellows

PNEUMATIC DEVICES OF CANADA, LTD.
14 Advance Road Toronto, Canada

Now you can see why only leads & pencils give you perfect



YOU ALWAYS GET PROVEN QUALITY FROM TURQUOISE DRAWING LEADS AND PENCILS

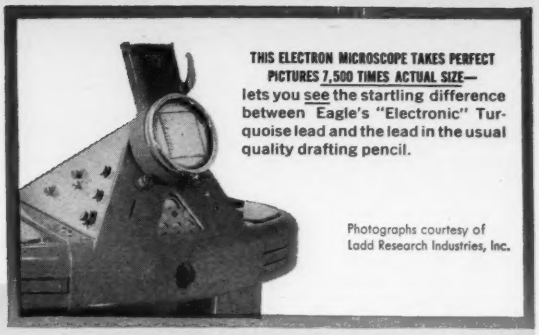
PROVEN GRADING -17 different formulae make sure you get exactly the line you expect—from every pencil, every time.

PROVEN DURABILITY—Because compact lead structure gives off no chunks of useless "dust" to blow away, Turquoise wears down more slowly.

PROVEN NEEDLE-POINT STRENGTH—as electron photomicrograph shows, Turquoise lead structure is finer—and therefore stronger. It holds a needle point under drawing pressures for long lines of unchanging width.

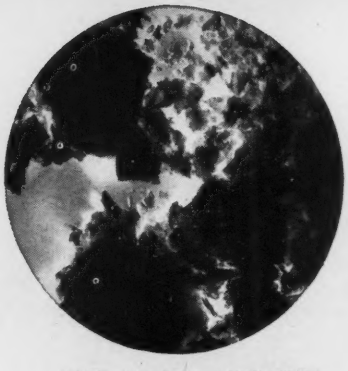
EAGLE PENCIL COMPANY • NEW YORK • LONDON • TORONTO • MEXICO • SYDNEY • BOGOTA

Eagle Turquoise reproduction



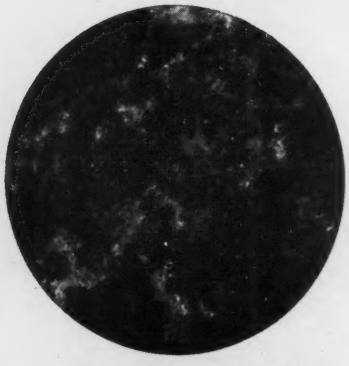
THIS ELECTRON MICROSCOPE TAKES PERFECT PICTURES 7,500 TIMES ACTUAL SIZE— lets you see the startling difference between Eagle's "Electronic" Turquoise lead and the lead in the usual quality drafting pencil.

Photographs courtesy of Ladd Research Industries, Inc.



...AND MARKS LIKE THIS

Relatively large, irregular particles of graphite make a rough-edged line with gaps that permit the passage of light. Prints will be inferior.



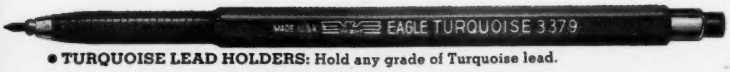
...AND MARKS LIKE THIS

Tiny, more uniform particles deposit as a clean-edged, solid opaque line that blocks the light and reproduces to perfection.

WRITE FOR FREE TURQUOISE SAMPLE
Write for a free Turquoise pencil or drawing lead, specifying grade desired, to Eagle Pencil Company of Canada, 217 Bay Street, Toronto, Canada

• **TURQUOISE DRAWING PENCILS:** "Electronic" graphite. 17 grades, 6B through 9H.

• **TURQUOISE DRAWING LEADS:**
Fit any standard lead holder. Grades 5B through 9H.



• **TURQUOISE LEAD HOLDERS:** Hold any grade of Turquoise lead.

EAGLE TURQUOISE

PENCILS AND LEADS

are the largest-selling in the United States and Canada!

Now! Get high impact strength plus mouldability

for high speed injection moulding

all in one great new Dow plastic

STYRON 475M

"M" stands for the mouldability now available in high impact STYRON* 475M. With this new formulation, you can bring more ideas to life . . . make them practical and economical.

STYRON 475M offers lower melt viscosity and permits freer flow of material into complicated, large area moulds. It makes thinner wall sections practical. Its easy mouldability means faster moulding cycles and increased production for a whole new range of Canadian products.

STYRON 475M adds the advantages of mouldability to the qualities that have made STYRON 475 Canada's favourite high impact polystyrene.

For further information contact our nearest sales office or write direct to: DOW CHEMICAL OF CANADA, LIMITED, 600 University Ave., Toronto 2, Ontario.

PERFORMANCE-PROVED FAMILY OF DOW PLASTICS

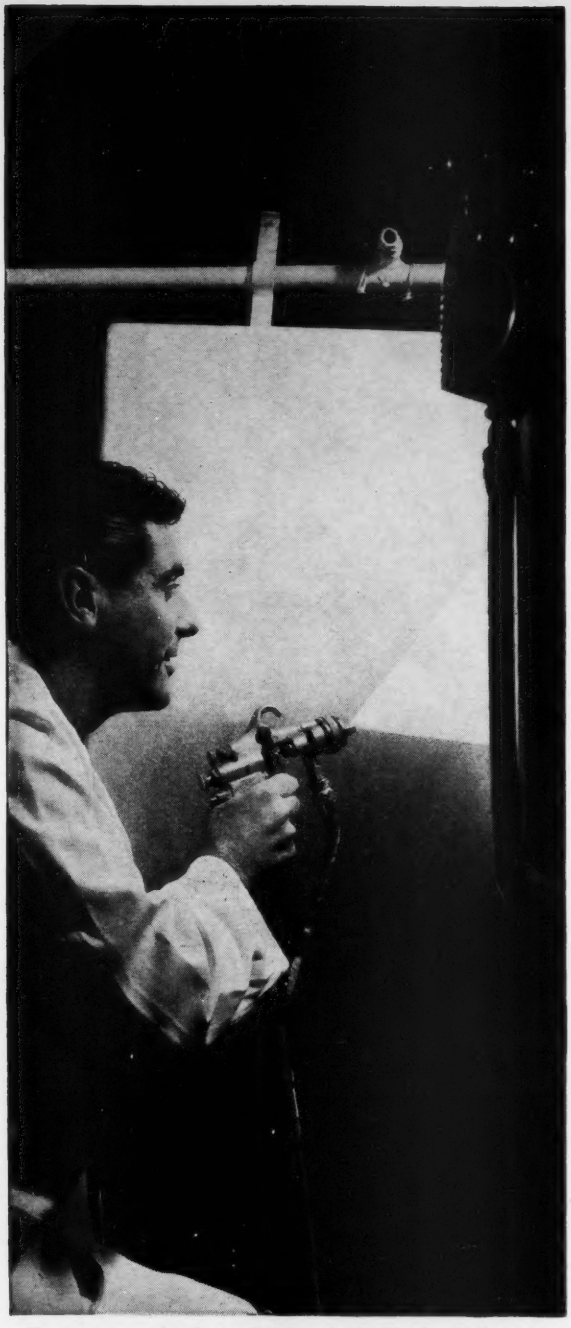
ETHOCEL*		EXCEPTIONAL TOUGHNESS	STYRON*	475M	EASY FLOW — HIGH IMPACT
STYRON*	666	GENERAL PURPOSE		777	MEDIUM IMPACT
	688	EASY FLOW		440	HIGH HEAT — HIGH IMPACT
	689	FAST FLOWING FORMULATION		480	EXTRA HIGH IMPACT
	475	HIGH IMPACT		700	HIGHEST HEAT RESISTANCE
TYRIL*		GOOD IMPACT — CHEMICAL RESISTANCE			

*Trademark of Dow Chemical of Canada, Limited

Plastics Basic to Canadian Living

DOW CHEMICALS

DOW CHEMICAL OF CANADA, LIMITED • CALGARY • MONTREAL • SARNIA • TORONTO • WINNIPEG



Test-step towards a better finish . . . in the Glidden Technical Service Department a refrigerator door is test-sprayed under conditions simulating actual production line conditions.

QUALITY Glidden PRODUCTS

GLIDDEN TAKES AN EXTRA STEP IN THEIR PLANT TO SAVE YOU TIME IN YOUR PLANT

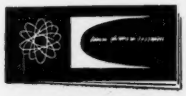
When Glidden works with you to develop a finish for your product, you can use it confidently on *your* production line. Time and money-wasting hold-ups involving finishing problems are reduced to a minimum under the Glidden plan! When we are asked to develop a finish, we study your product requirements, your production schedules and equipment.

Your problems, of necessity, become *our* problems. The Glidden Technical Service Department becomes—for test purposes on finishes—your plant! There we re-create the actual conditions under which your product is finished. Step by step we observe our finish in action—seeing how it behaves, making any changes and reformulations that are found to be necessary.

Before it leaves us, we make absolutely sure that the finish we have produced meets *your* requirements.

This, however, is only one facet of the Glidden Technical Service Department's work! Our highly qualified experts will work with you in your own plant or in the field. Their experience, supported by the finest scientific equipment is available to you.

Let us take extra steps for you—towards more economical, durable and better finishes! Please contact our service representative or write to us direct.



INFORMATION YOU'LL VALUE!
This Booklet outlines all Glidden Technical and Laboratory Services—and how you can profit by them. We will gladly send a free copy to plant executives on request. Just write to:

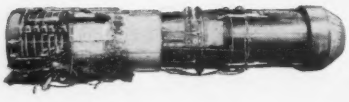
I-58-2

THE GLIDDEN COMPANY LIMITED

Technical Service Department • 351 Wallace Ave., Toronto, Ont. • 133 Elmslie St., Ville la Salle, Montreal 32, P.Q.

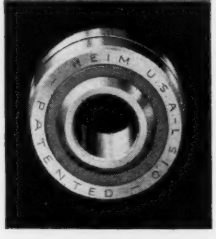
HEIM *Unibal*® Rod Ends

...in good company...



The new General Electric J79 jet engine has the highest thrust-to-weight ratio of any aircraft power plant in production. The engine is rated in the 10,000-pound thrust class.

Variable stators are used for the first time in a flying jet engine, which in a mechanically simplified way, and with far less weight, accomplish the same thing that the dual rotor does in other current engines. The device provides a smooth flow of air inside the engine and eliminates the "stall barrier" problem.



HEIM UNIBAL SPHERICAL BEARINGS and ROD ENDS supply the exact type of linkage, mounting, and degree of misalignment correction required by this engine, and The Heim Company is proud of its contribution to the success of the GE J79.

There are over 200 Unibal Rod Ends assembled with the variable pitch stator blade operating levers.

There are over 50 LS type Unibal Spherical Bearings used as pivot points for the inlet guide vanes.

The bearings which mount the engine to the airframe are three Heim Unibal cartridge units. These bearings carry the entire weight of the engine *and its thrust*.

Other Heim bearings of various types used on this engine bring the total to around 500.

* * * *

The load carrying capacity of Unibal spherical bearings is very high. They are applicable in any linkage where motion must be transmitted at constant or varying angles. They are ideal as supports to any device which is subject to mechanical or thermal deflection.

COMPLETE CATALOG AVAILABLE / SOLD THROUGH THE LEADING BEARING DISTRIBUTORS

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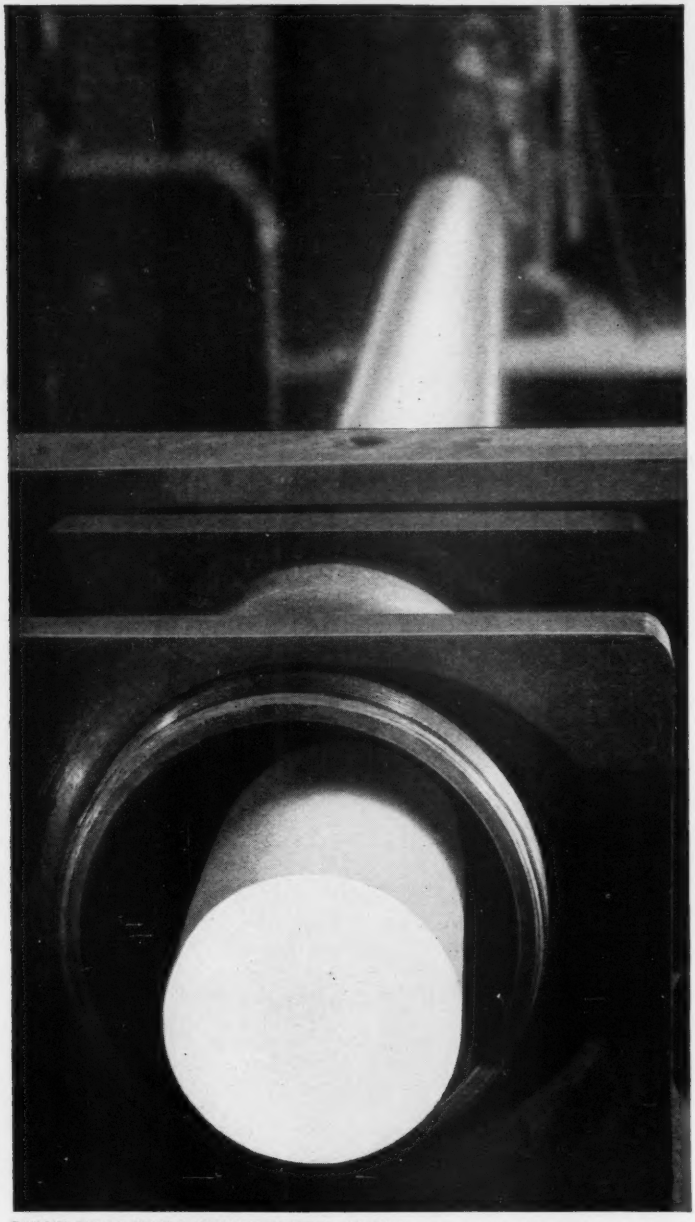
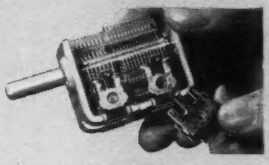


FAMOUS NYLON JOINS NATIONAL'S MATERIALS FAMILY. Proved in thousands of tough applications, versatile Nylon now becomes more useful to the designer than ever. National makes it so in extruded rods and 100% usable finished fabricated parts. Standard rod sizes range from ¼" through 2" in 3 and 6-foot lengths. Inquiries on other sizes and shapes are invited. National's expert engineering counsel assures the commercial soundness and economy of your product. And men, machines and capacity place National in a unique position to serve your immediate needs.

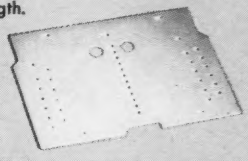
NATIONAL CAN HELP YOU reduce unit product cost or improve product performance at no added cost. Here's why: You can select the "one best material" from over 100 grades of PHENOLITE®, Vulcanized Fibre and NATIONAL Nylon—*without compromise in* properties or cost. You can simplify production and purchasing with the *timed delivery* of 100% usable parts—*from a single reliable source.* You gain competitively with National's new materials and grades —*the direct results of programmed materials-research.*

You benefit by calling National first. Check telephone directory yellow pages or write Toronto—Dept. *NI.*

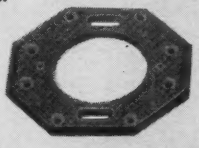
INTRODUCING 5 NEW superior PHENOLITE® Laminated Plastic Grades:



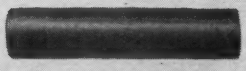
E-2040—A new low cold flow, hot punching paper base grade with good dielectric strength.



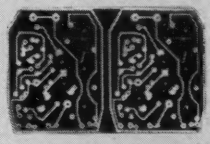
Y-2500—A good arc resistant paper base grade with excellent flame resistance plus superior punching and shaving characteristics.



G-8-881—A melamine bonded glass mat grade with excellent flame and arc resistant characteristics and good flexural and impact strength. Has high dimensional stability under humid conditions.



G-7-3604—A new thick-walled silicone fiber glass tubing material with exceptional heat resistance and electrical properties.



G-10-865—A new epoxy resin-bonded glass cloth sheet laminate with very low water absorption and excellent electrical properties.

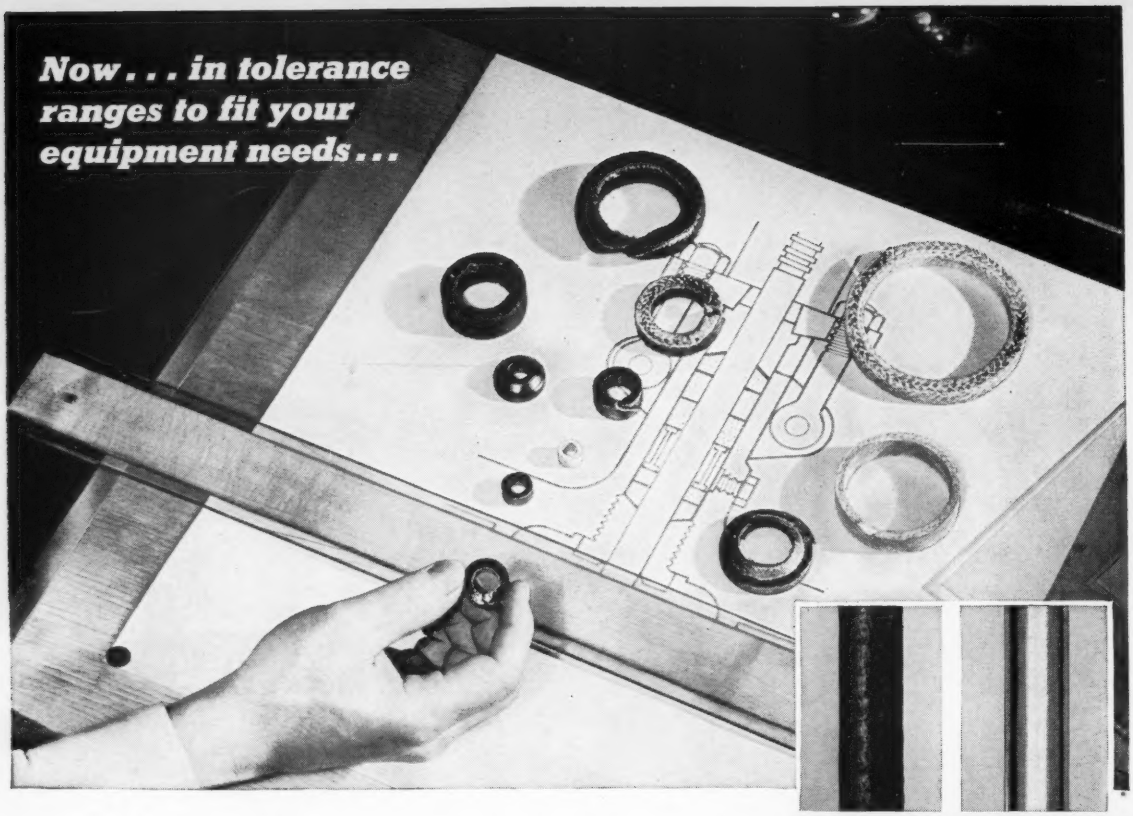
THESE FIVE NEW PHENOLITE GRADES bring to over 80 the number of standard and special grades of this versatile laminated plastic.

NATIONAL

FIBRE COMPANY OF CANADA, LTD.

ATLANTIC & HANNA AVENUES, TORONTO

1411 CRESCENT STREET, MONTREAL



Lasting corrosion protection for valve stems in storage. Ordinary corrosion inhibitors fail to protect after the sacrificial metal is consumed. J-M No. 9 operates on an entirely different principle. Photograph shows how, under accelerated tests, the sacrificial inhibitor (at left) failed after a few weeks *but the valve stem protected by J-M No. 9 (at right) was clean months later.* Specify J-M No. 9 inhibitor when you order J-M die-formed packing rings.

J-M Die-formed Packing Rings for all process fluids

Whether you are designing a bathroom fixture or a high-pressure valve, you can now choose your packing rings with greater certainty of both maximum sealability and easy assembly. For Johns-Manville has grouped its die-formed packing rings into three tolerance ranges—*dense, soft* and *metallic*—to fit your equipment needs.

Johns-Manville Die-Formed Packing Rings are precision-made for many fluid services including oils, tars, corrosives, solvents, fresh and salt water, steam to 1200 F, pressures to 4000 psi (on special valves to 60,000 psi). Special J-M rings with controlled friction are made for high-grade plumbing fixtures.

Check the tolerance chart below . . . your Johns-Manville Packing Representative will be glad to give you lists and descriptions of the styles in each range and those with which the J-M No. 9 Corrosion Inhibitor *(see right above)* may be specified or is standard. Write to Dept. IA, Canadian Johns-Manville Co. Ltd., Port Credit, Ontario.

JOHNS-MANVILLE DIE-FORMED PACKING RING TOLERANCES	DENSE RINGS (including plastics)			SOFT RINGS (including cloth rings)			METALLIC RINGS		
	I.D.	O.D.	Depth	I.D.	O.D.	Depth	I.D.	O.D.	Depth
to and incl. ½" O.D.	+.008" −.000"	+.000" −.008"	±1/64"	+.008" −.000"	+.000" −.015"	±1/64"	+.008" −.000"	+.000" −1/32"	±1/32"
Over ½" to and incl. 1" O.D.	+.008" −.000"	+.000" −.008"	±1/32"	+.008" −.000"	+.000" −.015"	±1/32"	+.008" −.000"	+.000" −1/32"	±1/32"
Over 1" to and incl. 2⅜" O.D.	+.008" −.000"	+.000" −1/64"	±1/32"	+.010" −.000"	+.000" −1/32"	±1/32"	+.008" −.000"	+.000" −1/32"	±1/32"
Over 2⅜" O.D.	+.010" −.000"	+.000" −1/32"	±1/32"	+.010" −.000"	+.000" −3/64"	±1/32"	+.008" −.000"	+.000" −1/32"	±1/32"

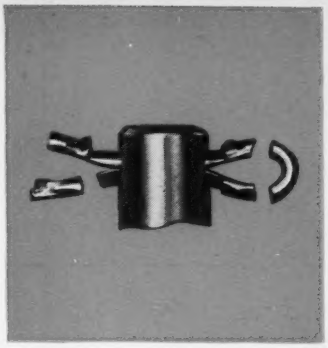
Bevel (on all styles) ±5° when required

JOHNS-MANVILLE JM PRODUCTS

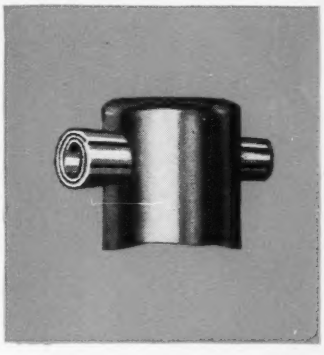
Johns-Manville PACKINGS, GASKETS and TEXTILES

1-3044

Spirol Pins in Morse Roller Chain resist vibration, absorb shock.



Standard heat-treated cotter pin fails after only 3 hours on fatigue tester. Failure in use means costly downtime.



Spirol Pin shows no sign of fatigue after 50 hours on tester. And it won't shake out or break off like cotter pins.

Another Morse advantage for Canadian users . . .

SPIROL PIN FASTENERS AT NO EXTRA COST . . . A MORSE ROLLER CHAIN EXCLUSIVE

Spirol Pins outlast any other fastener on the market! And they are now featured on Morse Roller Chain at no extra cost.

Spirol Pins resist vibration and shock—won't shake loose or break. These stronger fasteners cut down-time.

Spirol Pins are interchangeable with cotter pins on all Morse Roller Chain now in use. They are easy to install—require no special tools.

Morse Roller Chain has longer service life built in. Specially treated, precision-finished steel parts withstand shock and fatigue . . . reduce operating and maintenance costs.

These are the reasons you can depend upon Morse Roller Chain. So, call your Morse Distributor today for *all* your power transmission needs. His name is listed in the Yellow Pages of your telephone directory. Or write: *Morse Chain of Canada, Ltd., Simcoe, Ontario.*

IN POWER TRANSMISSION
THE TOUGH JOBS COME TO

MORSE*

*Trademark

designed for casting...

from TADANAC ZINC

The smooth operation of this modern spinning reel depends on balance and precision . . . hard use season after season demands durability and corrosion resistance. Competitive markets require economy. To meet these demands, the complex working parts of this reel are die cast Zinc!

Backed by one of the world's largest Zinc producers, Tadanac Zinc is the preferred brand with alloyers and die casters who demand consistent high purity, assured supply and prompt delivery.

For information or assistance regarding Zinc die casting operations, contact our Technical Service Staff. Your inquiries will be given immediate attention.

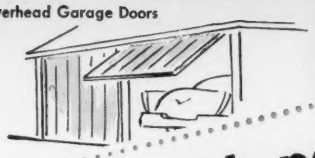
THE CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA LIMITED
Metal Sales Division: 215 St. James Street W., Montreal 1, Quebec, Canada

Sold in United States by: THE AMERICAN METAL COMPANY LTD.,
61 BROADWAY, NEW YORK 6, N.Y.,
1 NORTH LA SALLE STREET, CHICAGO, ILL.

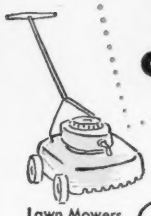
TADANAC ZINC SHAPES THE THINGS TO COME

57185-T

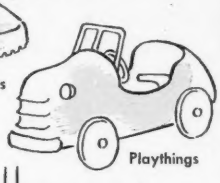
Overhead Garage Doors



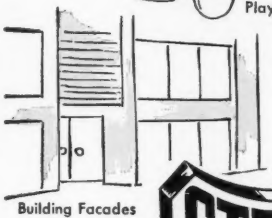
Holds paint like an artist's canvas!



Lawn Mowers



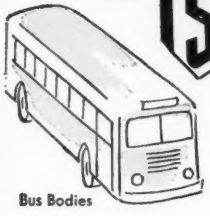
Playthings



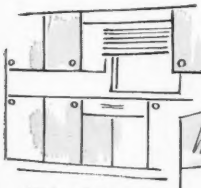
Building Facades

STELCO

"COLOURBOND" CONTINUOUS GALVANIZED STEEL SHEETS



Bus Bodies



Utility Tables

Kitchen Equipment

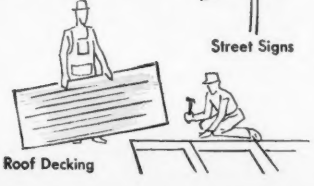
Store Fronts

Trailer Bodies

Picnic Coolers

Fishing Tackle and Tool Boxes

Street Signs



Roof Decking

The coating of pure zinc on Stelco's new "Colourbond" Continuous Galvanized Steel Sheets is applied by an exclusive technique developed by Stelco . . . it produces a soft lustre finish, perfectly suited to the close adhesion of paint and particularly acceptable when a bright surface spangle is not desirable.

No surface preparation is necessary, and no primer coat needed.

As with all other galvanized sheets produced by Stelco's patented continuous galvanizing process, the bond between the zinc and the steel is so tight that the sheets can be worked or formed to the limits of the base steel itself, without any sign of cracking or peeling of the zinc coating.

For every product or building application where a painted surface is required to combine with an anti-rust, anti-corrosion surface use Stelco "Colourbond" Galvanized Steel Sheets — available now, in sheets or coils.

For full information and metallurgical service, contact any Stelco Sales Office.

THE STEEL COMPANY OF CANADA, LIMITED

Executive Offices: Hamilton and Montreal

Sales Offices: Halifax, Saint John, Montreal, Ottawa, Toronto, Hamilton, London, Windsor, Winnipeg, Edmonton, Vancouver. J. C. Pratt & Co. Limited, St. John's, Newfoundland.

57071.A

PRODUCT OF 3M RESEARCH

1500 formulations for industry

If you have two or more surfaces to join, there's a "3M" Adhesive that will do it faster, cheaper and more securely. If there's a surface to protect from mechanical damage, fumes, etc., during processing or shipping, there's a "3M" Coating or Sealer to do the job. Just state your needs.

Write and let us prescribe the formulation

3M COMPANY

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MINNESOTA MINING & MANUFACTURING OF CANADA LIMITED
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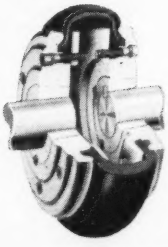
product news from United Steel
CORPORATION LIMITED

Flexible cushion coupling

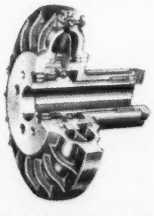
Known as the Para-flex Flexible Cushion Coupling this unit will take angular misalignment, parallel misalignment and end float—singly or simultaneously. In addition, it cushions shock loads, diminishes torsional vibration. Each Para-flex Coupling consists of two hubs and a flexing member greatly resembling a rubber tire. Both hubs are machined to take Taperlock Sprockets, permitting easy application to shafts of different diameter, without reboring. Para-flex Couplings are available to handle up to 700 horsepower in bore ranges from 4½" maximum, down.



No. 101

Dry fluid drive

The Flexidyne Dry Fluid Drive employs a new principle to provide a better solution to many drive problems. The "fluid" in the Flexidyne is a measured charge of steel shot which is contained in a housing —keyed to the shaft. When the motor is started centrifugal force throws the charge to the perimeter of the housing packing it between the housing and the rotor which transmits power to the load. This means that starting is gradual, with



No. 102

initial slippage, which protects the motor and equipment and allows smaller motors to be used. Once full load speed is attained there is no slippage and drive is 100% positive.

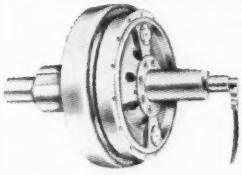
However if overload occurs (determined by the amount of shot in the charge) the Flexidyne will slip, tripping a thermal switch and shutting off the equipment. Flexidyne units are available in sizes to handle up to 75 horsepower, either as drives or couplings.

No. 103

Shaft-mounted speed reducers

The Torque-Arm Reducer is mounted directly on the driven shaft, **eliminating the need for** (1) a flexible coupling, (2) a belt take-up, (3) a reducer foundation. The Torque-Arm has a fixed ratio of reduction and is combined with a V-belt drive; depending on the sizes of the sheaves used, a wide choice of output speeds is possible. A Torque-Arm anchors the reducer and provides easy adjustment of the V-Belts through the use of a turnbuckle. The simplicity, ruggedness and light weight of this unit make it extremely easy to install. Just slip the reducer over the shaft, lock it in place, add oil, line up the sheaves, anchor and adjust the torque arm and the unit is ready to run.

This unit is available in sizes to handle up to 100 H.P. In most cases the Torque-Arm offers very substantial savings over conventional speed reducers.



No. 104

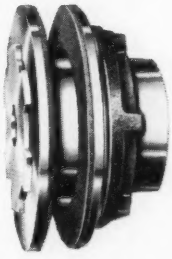
Air grip clutches

Here is an air clutch in which are embodied several unique features with a quick appeal to the operator. Because minimum air is required to operate the clutch the operator gets instant response to the control. The result is maximum sensitivity with finger-tip control and an ability to "inch" the clutch, or throw it into full engagement, as required.

The Air Seal Disc is located out of contact with the heat generating plates. This, together with internal ventilation, makes for cooler operation and longer life. Quick release valves can be supplied as optional equipment and provision is made for mechanical engagement in case of air supply failure. The Air Grip Clutch can be supplied in sizes to handle up to 5000 H.P.

Torque Limiter

The Torque Limiter consists of a driving or driven member in combination with a spring loaded friction mechanism which may be adjusted to slip when the desired torque is exceeded. The unit is compact, easily adjusted and tamperproof. It can be used in conjunction with any rotating member, such as sprockets, gears or pulleys. The Torque Limiter can be supplied to handle up to 620 ft. pounds of Torque.



No. 105

All of the items illustrated here are available for immediate delivery from stock at United Steel Corporation. These are just a few items from our tremendous range of mechanical power transmission equipment. Our warehouses are located at strategic points across Canada. Our staff of transmission experts is ready and waiting. Drop us a line or fill in the coupon below for an answer to **your** transmission problems.

MAIL COUPON TODAY

UNITED STEEL CORPORATION LIMITED
58 Pelham Avenue
Toronto 9, Ontario

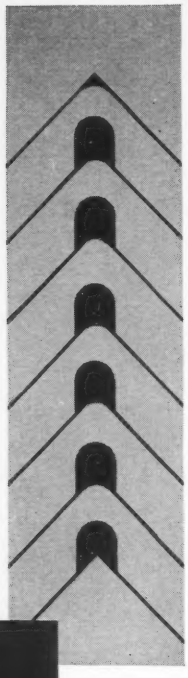
Please send me descriptive literature on:

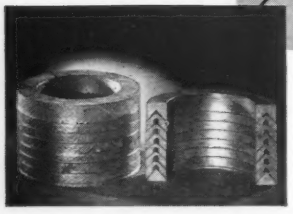
☐ NO. 101 ☐ NO. 102
☐ NO. 103 ☐ NO. 104 ☐ NO. 105

Name .....

Address .....

City ..... Prov. .....





Garlock CHEVRON Packing
Set and cross section

CHEVRON®

is a registered trademark of The Garlock Packing Company. It is our responsibility as the manufacturer to see that this trademark is properly used at all times to identify our hinge-type packings. We, therefore, ask that it be used only to designate our product. It should never be used merely as a descriptive or generic term for V-type packings.

CHEVRON Packings are carefully manufactured in Garlock's own factories by experienced craftsmen. Therefore, whenever you see this familiar trademark you can be sure that the packings described will give you long dependable service because they are properly designed and manufactured to the highest quality standards.

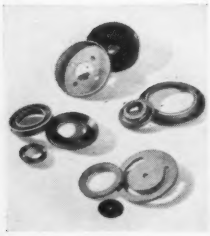
Other familiar registered trademarks belonging to Garlock include: BITAN Leather Packings, GUARDIAN Gaskets, KLOZURE Oil Seals, LATTICE BRAID Packings and MECHANIPAK Mechanical Seals. All of these products are sold to you under the Garlock Warranty . . . your assurance that they will satisfactorily perform the service for which they are designed.

THE GARLOCK PACKING COMPANY
OF CANADA LTD.

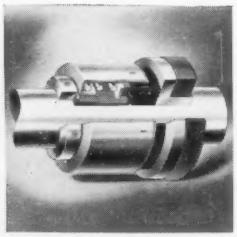
● General Offices: Toronto, Ont.
Branch Offices: Hamilton, Montreal, Winnipeg, Edmonton, Vancouver

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

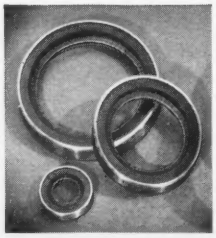


Garlock BITAN Leather
Cups, Packings and Gaskets

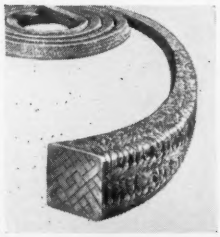


Garlock MECHANIPAK
Mechanical Seal

Garlock GUARDIAN
Spiral-Wound Gasket



Garlock KLOZURE Oil
and Grease Seals for Bearings



Garlock LATTICE-BRAID
Rod and Shaft Packings

Personalities

Important people who are in the news

William Bell of Guelph, Ont., has become district sales manager of controls and safety heads in the Toronto area for the company of Black, Sivills & Bryson, Ltd.

Bell, who has a broad background of experience in the manufacture and sale of automatic controls, is a graduate of the University of Toronto where he received his BS in mechanical engineering.

*

After 47 years continuous service with the Dominion Bridge Co., **Harry M. White,** the company's chief engineer, western division, has retired.

"H.M." (as he is known to his friends) received his early education in Chatham and graduated in mechanical engineering from the University of Toronto in 1910.

Successor to the post of chief engineer is **J. C. Trueman, BSc, MSc, PEng. M. J. Lupton, BSc, MEng, PEng.** takes over Mr. Trueman's job as structural engineer in charge of structural design, Winnipeg branch.

*

In December the Association of Professional Engineers of Ontario paid tribute to an extraordinary Canadian engineering pioneer — **Sir Sandford Fleming.**

This man, a Scotsman by birth, came to Canada with a degree in civil engineering before he was 20 years old. His achievements in Canada would fill a book.

He surveyed and planned the CNR route across Canada, was chief engineer of the Newfoundland Railway and the construction of Ontario's first railway, the Northern, was another of his achievements.

He invented "Standard Time," designed Canada's first postage stamp (the threepenny Beaver), was co-founder of the Royal Canadian Institute, lithographed the first large-scale maps of Canada, and gave the country its first direct communication with Australia via the Pacific cable. Not content with these achievements alone, he also wrote Canada's first interdenominational prayer book, hymnal and psalter.

He was Chancellor of Queen's University from 1880 until his death in 1915 at the age of 87.

*

Early in January the APEO elected **Charles Terry Carson** as its 1958 president.

In business life, Mr. Carson is vice-president and production manager of Hiram Walker & Sons Ltd. He is also chairman of the committee on engineering education at Assumption University, Windsor.

Carson, a member of the Association since 1946, has served on the executive council for five years, and last year was the Association's first vice-president.

*

Kenneth A. Thatcher has been appointed sales manager of Consolidated Diesel Electric of Canada Ltd.

Mr. Thatcher has a BS in mechancial engineering from the University of Capetown, S. Africa, and is a member of the Association of Professional Engineers, Province of Ontario.

*

Paul G. A. Brault has been appointed assistant chief engineer of the eastern division of the Dominion Bridge Co. Ltd.

A Montrealer by birth, Mr. Brault obtained his engineering education at McGill University, graduating in civil engineering in 1921. Prior to this recent appointment he had held the title of design engineer, eastern division.

*

The appointment of **George M. Hale** to the newly created position of vice-president and general manager has been announced by Canadian Resins & Chemicals Ltd.

Mr. Hale, who joined the company in 1946 on graduation from Queen's University, has been vice-president, sales, for the past year.

*

Gordon B. Tebo has been appointed manager of the laboratories at Canadian Standards Association.

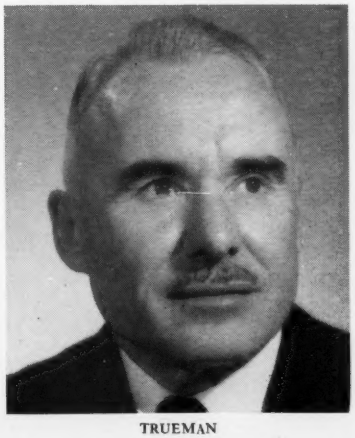
Mr. Tebo, who was born in Manitoba, received his early education in Ontario and graduated from the University of Toronto in electrical engineering with a BASc, in 1929. Before his appointment as director of research in 1953, Mr. Tebo held a number of key positions in the research division, including that of assistant director.

*

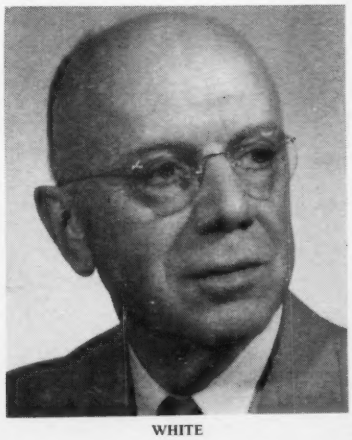
John R. Fitzpatrick is the newly appointed vice-president and general manager of Strippit Tool & Machine Ltd., of Brampton.

A University of Toronto BASc, in mechanical engineering, Mr. Fitzpatrick joined Strippit from a position as general manager of Peerless Engineering Ltd., of Toronto.

CARSON



TRUEMAN



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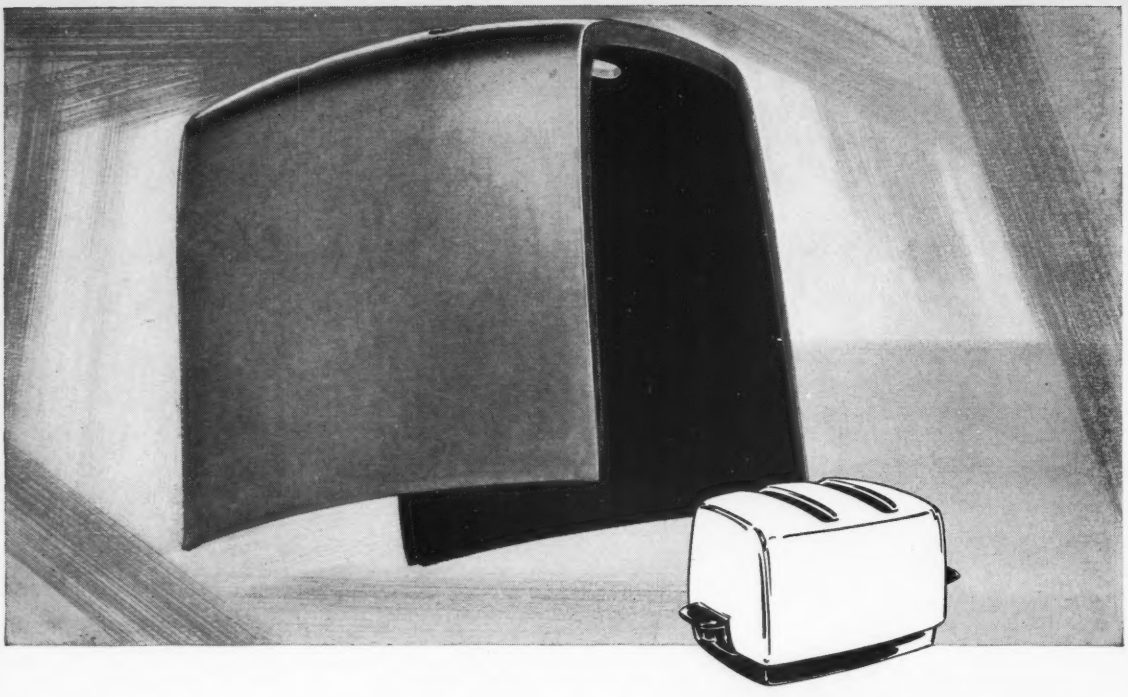
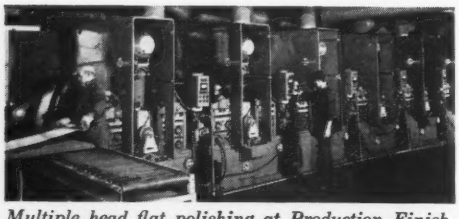
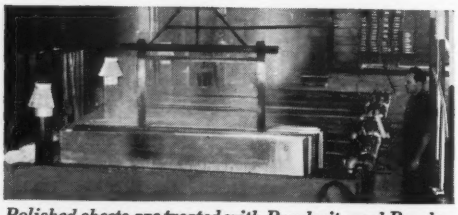


Form flat-polished metal without marring!
Use Bonderite and Bonderlube



Multiple head flat polishing at Production Finishing Corporation, Detroit.



Polished sheets are treated with Bonderite and Bonderlube before forming.

Bonderite and Bonderlube protect that smooth, flat-polished finish through forming and fabricating. Parts go direct to the plating bath from forming operations with only a light buffing.

All types of products are being made this way—automobile bumpers, automotive trim, toaster and small appliance bodies, home laundry equipment components and many other formed parts.

Cost reductions are big with Bonderite and Bonderlube: Polishing costs on bumpers went from 9c a square foot for contour polishing to 0.8c a square foot for flat polishing before forming. Savings of 10c to 30c a square foot have been reported by other industries.

The Parker technical representative has full information on this cost-cutting combination. A letter or phone call will bring it to you.

Since 1914—leader in the field

PARKER RUST PROOF COMPANY OF CANADA LTD.,
Rexdale Blvd., Rexdale (Toronto) Ontario

BONDERITE	BONDERITE and BONDERLUBE	PARCO COMPOUND	PARCO LUBRITE	TROPICAL
corrosion resistant paint base	aids in cold forming of metals	rust resistant	wear resistant for friction surfaces	heavy duty maintenance paints since 1883

*Bonderite, Bonderlube, Parco, Parco Lubrite, Parker Pre-Namel—Reg. U.S. Pat. Off.

Press cylinder redesigned to give longer wear resistance, smoother operation and better machinability.

Redesigning with gray iron castings

Here are interesting details of some of the winning entries in a redesign contest sponsored by the Gray Iron Founders' Society, Inc. of Cleveland, Ohio., the national organization for the gray iron casting industry. Object of the contest (which was open to all persons engaged in the metal-working industry): to give recognition to engineers for improvements resulting from the redesign of a part as a gray iron casting. It was necessary, when entering the contest, to state the function of the part (by describing the name of the equipment in which used and its purpose in that equipment) and why gray iron was chosen, based on the characteristics of the material, the cost savings, how it increased the efficiency of the finished product and its potential. "Before and after" details of cost, performance and so on had to be stated.

Type cylinder
Modification: Steel to gray iron.
Company: Virginia Foundry Co., Roanoke, Virginia.
The cylinder is used in an automatic imprint press to expose the type on material to be printed each time it revolves. (See illustration above.)

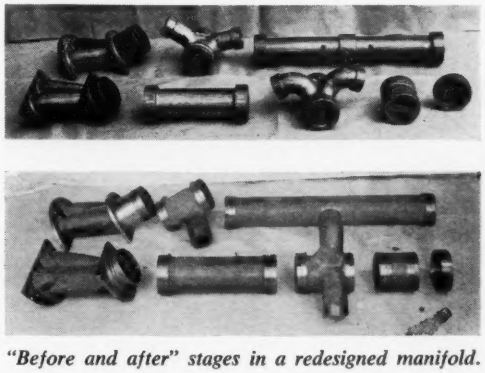
It was redesigned for the following reasons:—
Longer wear resistance and smoother operation.
Better machinability.
Saved 7 operations plus welding.
Cut overall costs 87%.

Exhaust manifold
Modification: From continuous weldment to S.G. iron.
Company: Cooper-Bessemer Corporation, Grove City, Pa.
The manifold conducts the exhaust gases from a diesel engine cylinder exhaust to the turbocharger. Temperature is 900-1000 F.

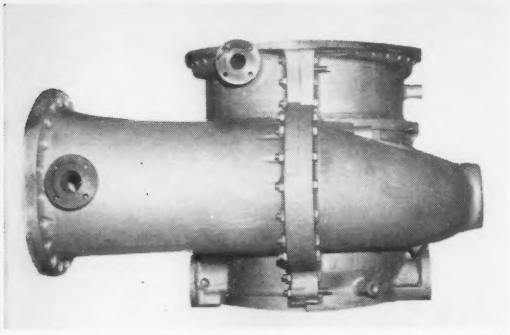
Part is made from S.G. iron (ASTM specification A 338, Class 60-45-10). It was formerly made as a continuous weldment but this failed regularly because of warping and scaling at the temperature.

The newer manifold was redesigned to consist of a number of individual castings which were machined as shown to allow for expansion.

S.G. iron was chosen because of its excellent scale resistance and elevated temperature strength. The application was successful.



"Before and after" stages in a redesigned manifold.



A number of the earlier casings were made in steel.

Redesigned casing in gray iron cut costs all around.

Compressor discharge casing
Modification: Steel to gray iron.
Company: General Electric, Foundry Department, Schenectady.

This casing provides an efficient passage of air from an axial flow compressor to a regenerator. The air is subsequently used for combustion in a land-based gas turbine, of which the compressor is an integral part. The compressor discharge casing is also an important structural member of the gas turbine unit.

Originally, the first of these units was produced on a short time basis with no previous experience of this type of equipment to rely on. The designers therefore felt it best to be conservative and so they specified steel for the discharge casing, since it would provide adequate strength and also permit modifications during manufacture, if tests made changes necessary. A later modification was made so that part of the compressor casing was a cast-weldment. In order to obtain the degree of soundness required, it was better to use this technique rather than make the compressor casing an integral part of the discharge casing castings. This design proved satisfactory and a considerable number of units were produced as shown in the left hand figure.

How modified

Continued evaluation, however, led to a redesign of these parts in order to make use of high strength (40,000 psi tensile) gray iron. At the same time, several design modifications were made (to increase the efficiency and reduce costs) such as the use of a single outlet instead of two. Since shrinkage problems are much less in iron, it was possible to make the compressor casing an integral part of the discharge casing. Figure (top right) shows the complete gray iron discharge casing.

The savings itemized below are due to the change of material alone; they do not include savings that were the result of other changes in the design.

Savings in material cost.....	58%
Savings in machining cost.....	34%
Reduction in weight.....	38%
Reduction in manufacturing time	25%

This change to gray iron is very successful and is acting as an incentive for further applications of gray iron to gas turbines.

This part is used on a vertical broaching machine. A switch to ductile iron eliminated its tendency to bow.

Broach holder
Modification: Change to ductile iron.
Company: Continental Tool Works Division, Detroit, Michigan.

The part is used on a vertical broaching machine after the broach inserts are installed in the holder. This is a highly critical operation for finish broaching titanium air-compressor blades.

Several holders of this type (up to 87 in. long) are in use. After installing and removing the holders several times from the machine it was found that the holder would bow, causing difficulty in maintaining the close tolerances necessary on the parts. In switching to ductile iron it has been possible to overcome this difficulty, and also to eliminate scraping in the slots in the holder into which the broaches fit. This is because of the stability of the ductile iron. These holders have been in use for the past 2 years and have resulted in reduced set-up time and scrap.

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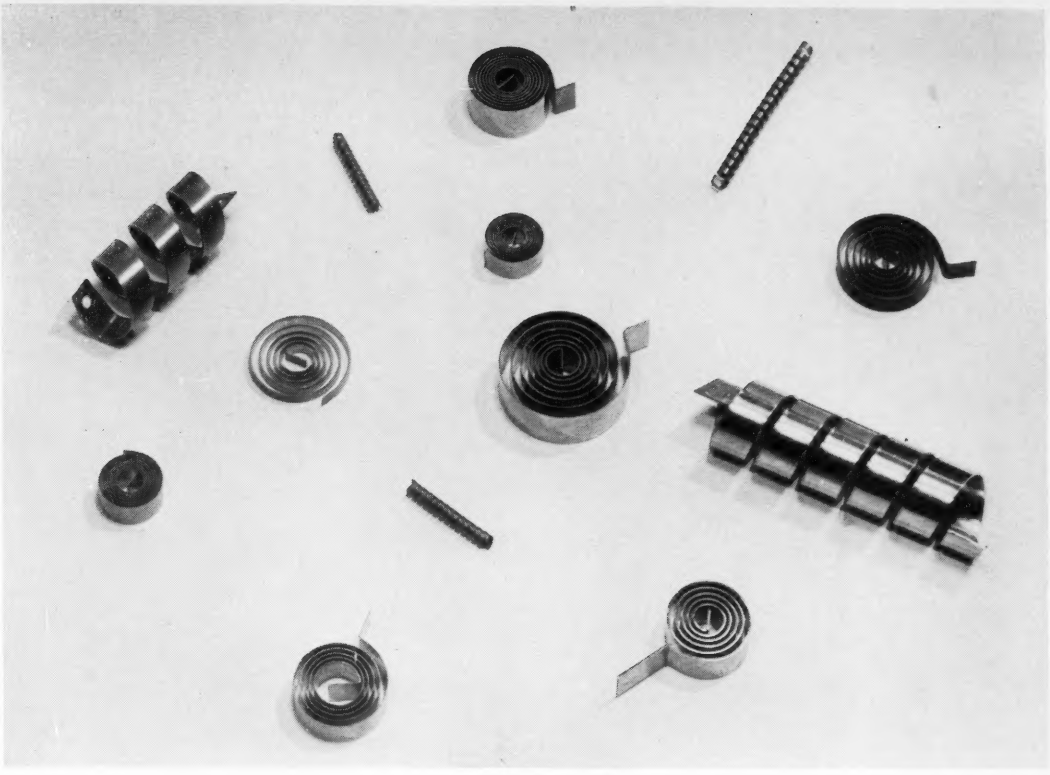


A new procedure for thermostat design

"Despite their new uses, engineers usually know little about them"

By Allen C. Gilbraith

This article describes a hitherto unreported procedure for the design of thermostatic elements.

There are two reasons why it should be of great interest to readers of Design Engineering:

(1) Although the use of thermostatic elements has mushroomed in recent years in military, industrial and consumer applications (the new satellite surely contains at least one), there is a paucity of knowledge concerning their design among engineers.

(2) The method offers the engineer an extraordinarily simple method of solving (in one operation) his three major design problems: thermostatic metal selection, shape and size.

In short, the article serves as a down-to-earth guide to all major aspects of thermostatic design and some minor ones too. It is the result of a half-year's research with the activities of many companies. The facts are reported objectively.

The design problem begins with the selection of the bimetal.

This is a strip composed of two metals, one of which (with a high coefficient of expansion) is laminated to the other (with a low coefficient of expansion). The metals are bonded by the application of temperature and pressure to form a compact single bar. The resulting bimetal can be readily machined, formed, blanked, welded, soldered or electroplated as if it were a single metal.

Dimensions are precise, with thickness tolerances as low as ± 0.00015 in., width tolerances as low as ± 0.002 in. and length tolerances as low as ± 0.030 in. Thicknesses are produced as low as 0.0049 in.

How does a bimetal work? When a bimetal strip is heated, the high-expansion component expands. The low-expansion component, on the other hand, expands little, if at all. Since the two components are inseparably bonded, the low-expansion component acts as a restraining force on the high-expansion component. The result is a bending action.

With the restoration of normal temperature, the metals contract to their original dimensions. The deflection cycle is then repeated at the next temperature rise and subsequent return to normal. Modern manu-

facturing methods produce thermostat bimetals capable of an infinite number of such deflection cycles.

It should be noted that a temperature loss can produce a curvature as well as a temperature gain, the metal bending in the opposite direction. Wherever there is a heat differential, the thermostat bimetal is activated. Any type of heat differential can accomplish this. Radiation, convection and conduction are common sources. Of special interest to the designer of electrical thermostatic elements is the heat differential induced by an electrical current in the bimetal, the I^2R effect. A thermostatic element can therefore be activated in two ways:

(1) by ambient temperature, as in a room thermostat:
(2) by internally induced temperature, as in a circuit breaker.

The curvature produced in the bimetal as a result of the thermal differential develops a mechanical force. This is similar to the force produced by curving a beam. A bimetal is consequently a device for converting thermal energy into mechanical energy and this mechanical energy is the motivating force behind bimetal controls. In many cases, the bimetal element produces sufficient useful work to power the regulatory device by direct mechanical action. When the work produced by the bimetal is insufficient, the deformation is then used to trigger a stronger source of energy.

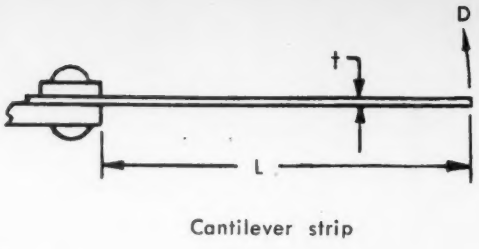
A bimetal can be used to compensate for, regulate and indicate temperature changes—automatically. It is a dependable, low-cost, self-powered device for governing, measuring and protecting. Wherever these results are desired, the bimetal offers a simple solution for many otherwise obstinate design engineering problems. Because of this, bimetal control devices are being used in an increasing number of diverse applications, both industrial and domestic.

For example, bimetal thermostatic elements make possible furnace controls, oven thermometers, room thermostats, coffee makers, heating blankets and many other taken-for-granted conveniences. Industry relies on bimetals for such devices as pressure gauges, demand indicators, shaft rotators, circuit breakers, overload protective devices, thermal relays, motor starters, timers and flow regulators. Automatic chokes head a list of more than a dozen applications in today's automobiles.

What is the basic design problem? At the commencement of his problem, the design engineer must supply the answers to the following questions:

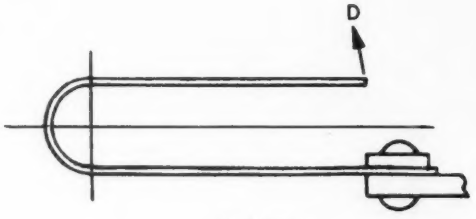
What is the thermostatic element required to do. Indicate, regulate or compensate?
What are the "special" service conditions?
What is the over-all temperature range at which it will be required to operate?
What is the maximum temperature to which it will be subjected?
What are the dimensional limitations?
What force must be generated?
What deflection?

The designer is equipped (within limits) with the answers to these questions. Translating them into an economical and efficient thermostatic element constitutes his basic design problem. It involves a bewildering number of variables, almost all of which are interdependent. It is his task, fundamentally, to convert these variables into the optimum constants for the



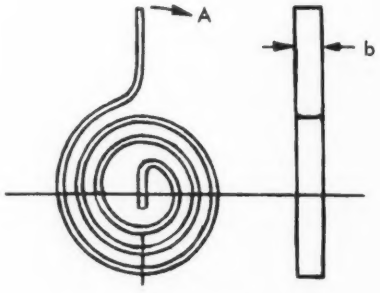
Cantilever strip

Figure 1



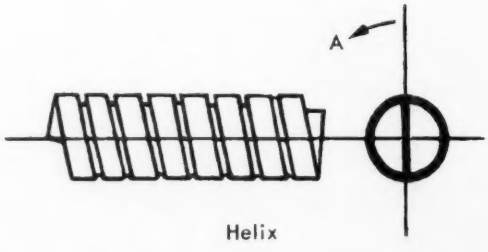
U-Shape

Figure 2



Coil

Figure 3



Helix

Figure 4

application he has in mind. In what order this conversion is undertaken depends, in large measure, on the special nature of his problem, and on his own mental proclivities. The logical starting point for most design engineers, however, is the selection of the bimetal. Using this starting point, a method will be described for the simultaneous selection of the best-for-a-specific application bimetal, the shape of the bimetal and the dimensions for that bimetal.

Choosing the bimetal. Approximately 200 bimetals can now be procured for commercial producers in the Northern Hemisphere. Unless the design requirements are of the most extraordinary nature, the design engineer is certain to find many bimetals that will meet his specifications. From the wealth of material at his disposal, how does he delimit his selection?

It is the practice of most thermostat design engineers to make the "special" consideration, the prime consideration. This practice has been established because it rapidly shrinks the field of selection.

Let us suppose, for example, that high corrosion-resistance at a given temperature is a requirement. Many bimetals will operate in the given temperature range, but few will supply the needed high resistance to corrosion. By making corrosion-resistance the first "knock-out" factor, the number of "possible" bimetals is sharply reduced. It is apparent that when there is a multiplicity of "special" requirements, the field of selection dwindles even more rapidly.

To narrow the field further, the design engineer now assesses the remaining "possible" bimetals against his temperature requirements. The first of these is "maximum operating temperature." Each bimetal possesses an upper temperature limit beyond which it is likely to "set" (that is, fail to return to its original position), thus rendering it useless. The design engineer knows the highest temperature at which his thermostatic element will be required to operate. By comparing that temperature with the manufacturer's specifications for "maximum operating temperature," he is able to weed out the bimetals that cannot perform beyond his temperature ceiling.

The designer has now selected a group of bimetals that will perform satisfactorily **below** the "maximum operating temperature." But, in addition to "maximum operating temperature," he also knows:

(1) the over-all range of temperature in which the thermostat metal will be required to work.
(2) the portion of that range in which the bimetal's greatest sensitivity is required.

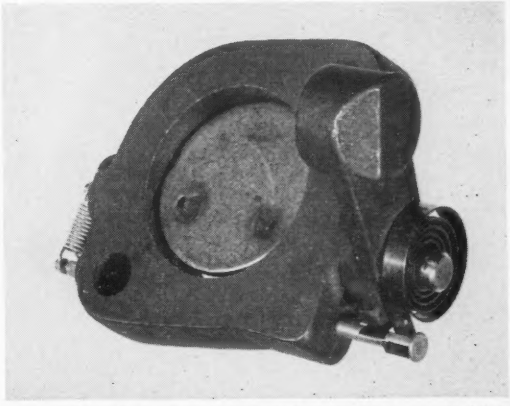
Two sets of data (empirically determined by the manufacturer) help the engineer compare "what he must have" with "what he can get." These sets of data are classified as "the useful deflection temperature range" and "the maximum sensitivity temperature range."

	Maximum operating temperature	Useful deflection temperature range	Maximum Sensitivity temperature range
Bimetal A	1000 F	—100 to 1000 F	200 to 600 F
Bimetal B	1000 F	—100 to 1000 F	0 to 800 F
Bimetal C	1000 F	—100 to 700 F	0 to 300 F

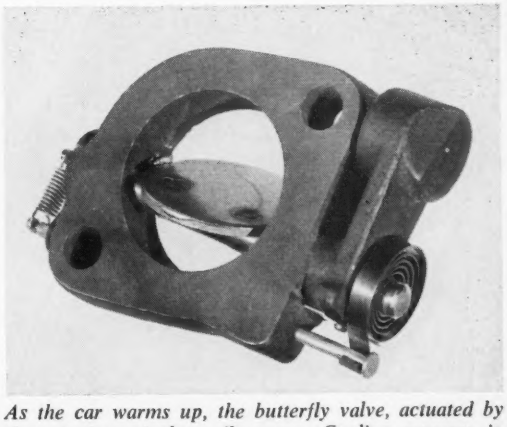
To clarify the use of these data, consider the following highly simplified hypothetical case. Suppose that, as a result of a mandatory "maximum operating temperature" of 1000 F, the bimetal "possibles" have been reduced to three. (Actually, there are **many** bimetals that function efficiently below 1000 F, but, in this instance, we can assume that "special" service considerations have eliminated all except the three under discussion.) For these three the manufacturer has supplied the information given in Table 1.

Now, the engineer knows that his thermostatic element will be required to perform most frequently within the over-all range of 0 to 750 F. Bimetal C (with a useful deflection temperature range of —100 to only 700 F) is therefore eliminated; but bimetals A and B (with identical ranges of —100 to 1000 F) both remain in the running. However, the designer knows, in addition, that the maximum sensitivity will be demanded within the range 100 to 650 F. Bimetal A's maximum sensitivity temperature range extends only from 200 to 600 F, which is inadequate. Bimetal B's range, on the other hand, extends from 0 to 800 F and encompasses the required temperatures. B is thus selected.

In practice, however, the designer will conclude



Butterfly valve of an automotive exhaust manifold is closed, bypassing the exhaust to give a quick warmup.



As the car warms up, the butterfly valve, actuated by the rotation of the coil, opens. Cooling reverses it.

his appraisal on the basis of operating temperatures with not just one bimetal but a good many "possibles." To determine which of these will perform most efficiently he now compares the "thermal activity" of each bimetal. This characteristic of a bimetal has been standardized by the ASTM as "flexivity." It is defined as "the change in curvature of the longitudinal centre line of the specimen per unit temperature change per unit thickness." It is determined by measuring the deflection of the bimetal strip when subjected to a temperature change. The flexivity is a measure of the motion of the bimetal, as well as of the force it can develop. Ordinarily, therefore, the designer will select the bimetal exhibiting the greatest flexivity, all other characteristics being equal.

Does the process of elimination we have just described complete the bimetal selection? Unless it produces one (and only one) bimetal, the answer is "no." Ordinarily, at the end of the process, the design engineer will find he has several bimetals, all of which meet his specifications. Which one of these will he decide on?

The final choice of bimetal must be made simultaneously with two other design factors, namely: the shape to which the bimetal will be fabricated and its dimensions. This simultaneous selection is necessary because the desired motion and force characteristics

	For deflection	For force
Cantilever strips	$D = \frac{K \Delta T L^2}{t}$	$P = \frac{YDb\,t^3}{L}$
U shapes	$D = \frac{K \Delta T L^2}{2t}$	$P = \frac{4\,Y\,D\,b\,t^3}{L}$
Spiral or helix coils	$A = \frac{C \Delta T L}{t}$	$P = \frac{Z\,A\,bt^3}{L\,r}$

D = deflection (in.)
ΔT = temperature differential (deg F)
L = Length of the strip (in.)
t = thickness of the strip (in.)
P = force (oz)
Y = the force constant for the strip
K = the deflection constant for strip
b = the width of the strip (in.)
A = the angular rotation (deg)
C = the deflection constant for spiral and helix coils
Z = the force constant for spiral or helix coils
r = the radius (in.) of the applied load.

Deflection and force constants

Values for C, K, Y and Z in the formulas are the intrinsic properties of the bimetal that (as mentioned previously) help determine the force and deflection values of the thermostatic element. The deflection constant (the designer is cautioned), varies with the temperature, and he must be careful to correlate it with his operating temperature before substituting in the formulas.

Calculations when both force and motion are required.

The formulas given above are applicable for the calculation of force and deflection when the thermostatic element is either completely free or completely restrained. That is, when force alone (or motion alone) is required. When there is partial restraint, so that both force and motion are required, the following formulas are used:

(a) For cantilever:

$$PD = \frac{K^2\,Y\,\Delta T^2\,Lbt}{4}$$

(b) For U-shape:

$$PD = \frac{K^2\,Y\,\Delta T^2\,Lbt}{4}$$

(c) For spiral or helix coil:

$$PA = \frac{C^2\,Z\,\Delta T^2\,Lbt}{4r}$$

From the equations it is obvious that both force and motion are functions of the temperature differential. In what proportion? This is for the design engineer to decide, and he can do so by assuming that a portion of the temperature differential accounts for the required deflection, and the remainder for the force developed. It is to be noted that, although any portion of the temperature differential can be allocated to either force or deflection, the proportions selected will determine the dimensions of the element. In most cases the design engineer can be guided by the following rule: **Use half the temperature differential to calculate force, the other half for deflection.** This will result in maximum effectiveness and compactness of design.

Accuracy of the formulas

The design engineer is warned that the formulas are accurate enough to move his project from drawing board to testing laboratory, but not accurate enough to solve his problems without check tests. The formulas are only a guide: an excellent guide, but still only a guide. Actual testing is always necessary before going into production. The final calculations on the basis of the formulas (plus experience in operation) will determine the specifications on the "OK for production" print.

of the fabricated thermostatic element are determined not only by the nature of the bimetal of which it is composed, but by the contour and size of that element as well. Because these three major variables are interrelated, they must be considered together. But juggling them around is a formidable task. Can it, therefore, be simplified? We promised just such a simplification when we proposed a method for arriving at the solution of all three variable problems at the same time.

The first step in the development of that method is a consideration of the possible shapes of the thermostatic element.

Theoretically, there is no limit to the number of shapes into which the bimetal can be formed. As a matter of manufacturing practice, however, they fall into four general categories:

(a) The cantilever strip (Fig. 1)
(b) The U-Shape (Fig. 2)
(c) the coil (Fig. 3) and
(d) the helix (Fig. 4).

Of these four basic shapes, which shall the design engineer employ? He will make his primarly shape selection on the basis of the type of motion required.

The basic thermostatic element shapes produce two types of motion: essentially linear or essentially rotational. When the former is desired (as in an electrical cut-out), the designer will select a cantilever strip or U-Shape. When the latter is desired he will select a spiral coil or helix.

Based solely on the kind of motion required, therefore, the thermostatic element designer eliminates two of the four basic shapes. (In many cases, of course, no motion is required at all, whereupon all four basic shapes are "possibles.")

Remember, the thermostat bimetal is a device for translating thermal energy into mechancial energy. The mechanical energy so produced can take the form of motion, force or a combination of the two, depending on the nature of the restraint placed on the deflection. On this basis, thermostatic elements can be employed in one of three ways:

(1) **With no restraint of deflection,** in which case none of the mechanical energy of deflection is converted into force. Typical example: a temperature indicating dial.
(2) **With complete restraint of deflection,** in which case the mechanical energy of deflection is entirely converted into force. Typical example: temperature compensating devices.
(3) **With partial restraint of deflection,** in which case part of the mechanical energy of deflection is converted into force, and both motion and force are produced. Typical example: automotive chokes.

It is important that the designer clearly establish the nature of the work the thermostatic element is to perform, because under each of these conditions, the identical thermostatic element (everything else equal) will produce different force and deflection values. It is to be noted, moreover, that these values vary, not only with the shape of the element, but also with its dimensions, with the nature of the bimetal and with the temperature differential.

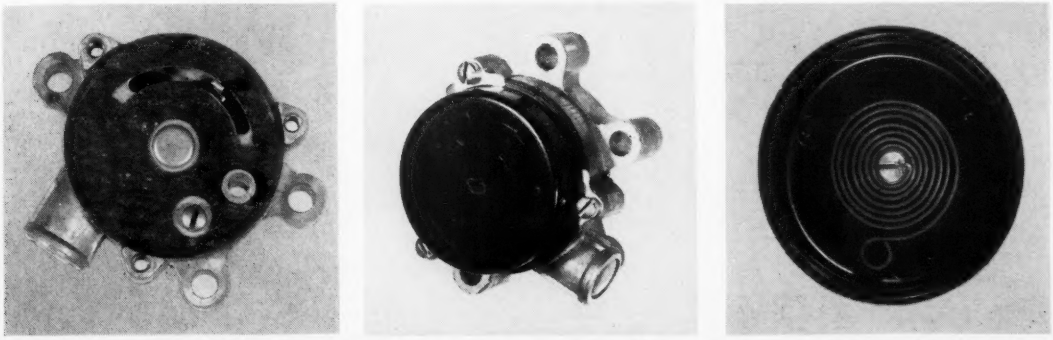
At first glance, therefore, it would seem that we have again a large number of variables to consider, involving complex calculations. Actually, this is not so. Many of the variables are so-called "limited variables" (that is, they are constant within limits). This is made clear by an examination of the factors involved.

For example, from the nature of the problem, the designer has already calculated the force and motion that will be required for maximum efficiency. He has determined, too, which of the three conditions of work satisfy the function for which the thermostat is designed, and he also knows the temperature range at which the thermostat must operate. These factors, therefore, are constants. In addition, the over-all dimensions of the thermostat proper have prefixed the size of the thermostatic element within limits (ordinarily fairly restrictive). Moreover, the process of bimetal selection (previously discussed) has reduced the number of "possibles" to a limited quantity. Which, then, of the factors influencing force and deflection, remains **truly** variable? The answer is: the shape of the thermostatic element.

This is determined in two simple steps:
(1) Substitute the values for the constants and limited variables (discussed above) in well-established formulas for force and deflection which exist for each of the basic thermostatic element shapes.
(2) Compare the calculated values for force and deflection so obtained with the values required.

The shape that produces force and deflection values most closely approaching the values predetermined by the designer is the shape to employ.

The computation of these values is a fairly straightforward task, thanks to the development of simple formulas for force and deflection for each of the three conditions of work in each of the four basic shapes. Therefore, once the condition of work has been selected, the designer has available a formula for each of the basic shapes that will give him the values of force and deflection for that shape produced by any given set of dimensions, temperature differential and thermo-



Exploded views of an automatic choke. Thermostatic coil rotates with temperature to adjust gas-air mixture.

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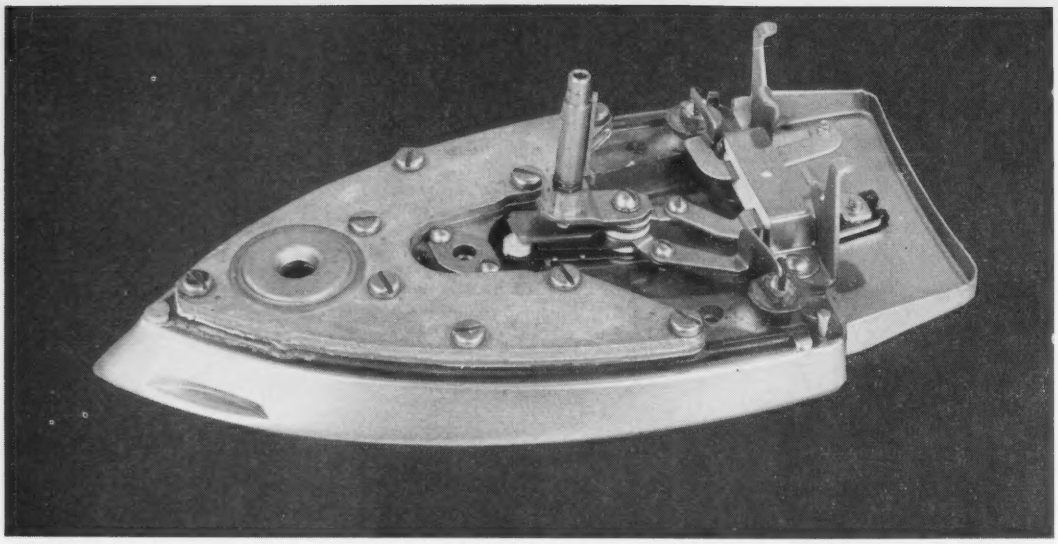


1. Mounting of the bimetal leaf type thermostat is simply done by an 8/32 screw through its hollow stack. The low cost, narrow differential and long service life of this thermostat make it the ideal selection for applications such as this Hoover steam or dry iron. Some other applications for this unit include wafflers and fans.

Each thermostat does only one job well

"Thermostats can be square pegs in round holes without half trying"

Paul Dahlen STEVENS MFG. CO. INC.

Since World War II, new uses for thermostats in military, industrial and consumer goods have grown so fast that thermostat manufacturers, although more than triple in number, have had a hard time keeping up with the demand. And by demand is not meant quantity but rather types of thermostat.

For thermostats are peculiar devices in that each must originally be designed to do a specific job best. Every type has certain characteristics and capabilities that give it a personality all its own. A thermostat can be a square peg in a round hole without half trying.

For this reason, new types of thermostat are constantly being developed to meet new applications. The large bimetal disc type thermostat with a 25 amp capacity was designed to meet the need of the clothes dryer industry. The bimetal leaf creep type thermostat was designed specifically for the household flat iron.

Following this condition-cure procedure through the years, the thermostat industry can now set before the designer with a heat control problem an impressive array of some 60 different types of thermostat from which to choose. No two are exactly alike. Each one is superior in some respects, sadly lacking in others.

Yet picking the best thermostat for any particular application is not as hard as it sounds. First, a cursory consideration will eliminate all but two or three types which can then be considered more closely; second, almost all the more widely used small appliance type thermostats are based on one of three basic methods of heat motivation. Their individuality springs mainly from size, load capacity, location of the heat sensing member, type of switching mechanism employed and housing.

Before beginning a discussion of contemporary thermostats, we shall mention some of the terms peculiar to the thermostat industry. To a thermostat engineer, the **differential** is the difference between the temperature at which the contacts open and that at which they close. In disc type snap acting units, the **average differential** is the difference between the nominal opening temperature and the nominal closing temperature. That is, open at 150 ± 5F, close at 100 ∓ 10F. The average differential is 50 F. An **adjustable thermostat** is one which the ultimate consumer can adjust to select his own operating temperatures, such as in a household flat iron. The **non-adjustable thermostat** is preset at the thermostat factory and its setting either cannot be changed at all or (as in some thermostats), only by a serviceman. **Thermal range** is available only in adjustable thermostats and refers to the range of temperatures through which the thermostat can be made to operate by rotating its adjusting shaft. **Normally closed contacts** open on a temperature rise, while **normally open contacts** close on such a rise. **Snap acting thermostats** have contacts that open instantaneously and move through a definite fixed distance, much the same as the contacts in a light switch. **Creep type thermostats** have contacts that are

simply pushed open by the motivating member with no means of displacement other than that caused by this member. **Calibration tolerance** is that spread of temperatures within which any thermostat in a group must operate or be rejected.

It should be noted that when temperatures are given throughout this article, they refer strictly to temperatures measured on the bimetal or heat sensing element of the control. The thermostat manufacturer can only be responsible for these temperatures, for he has no direct control over the subsequent use or application of his product.

The two switching principles

In general, thermostats employ one of two switching principles. They have either **creep** or **snap acting contacts.**

Thermostats with creep type contacts are usually lower in cost and have narrow temperature differentials at higher temperatures. They are also subject to contact chatter under vibration and can cause unwanted radio and TV interference.

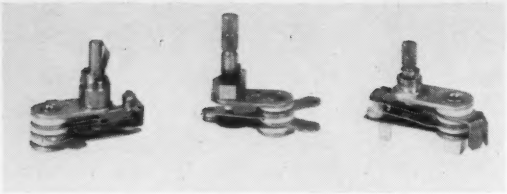
Controls with snap acting contacts, on the other hand, although more expensive and with wider temperature differentials, offer higher load capacities (both resistive and inductive), are vibration resistant and can be used to operate relays and solenoids without chatter, minimize radio and TV interference and usually produce longer contact life under any given set of conditions.

Because of these differences, creep type thermostats are favored for home appliances of intermittent use (such as the flat iron or electric skillet) while the snap acting units are favored in 24 hr per day applications, such as water heaters, furnace controls and so on.

Referring again to the three basic types of heat motivation found in small, appliance-type thermostats on the market today, the controls to be discussed here will be classified on this basis and will include the bimetal leaf type, the bimetal disc type and the newer expanding probe type thermostat.

Bimetal leaf type: The least expensive and widest used appliance type thermostat is the bimetal leaf type (shown in Fig. 2 (a) and the box item). This thermostat is generally considered to have creep type contacts, although the mechanical friction that the bimetal insulating button must overcome in sliding along the top contact blade to open the contacts, provides a definite measurable temperature differential. It is this differential that not only gives the thermostat long

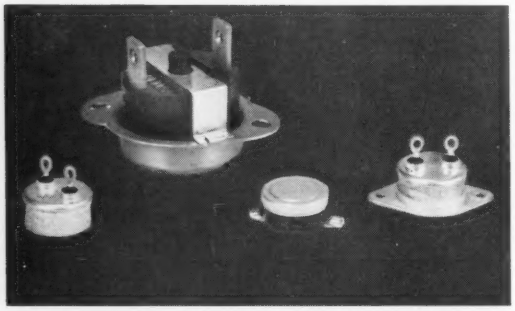
Type of thermostat / typical data		Bimetal leaf type			Bimetal disc type		Expanding probe type
		Creep type contacts	Snap acting contacts	Current carrying bimetal	½ in. diameter disc	1 in. diameter disc	
Maximum CSA load based on 100,000 cyles of operation	Resistive	13.3 AMP 120 VAC	13.3 AMP 120 VAC	—	4 AMP 120 VAC	25 AMP 240 VAC	13.3 AMP 120 VAC
	Inductive	1/6 HP 120 VAC	⅓ HP 230 VAC	—	1/6 HP 120 VAC	½ HP 240 VAC	—
Minimum average temperature differential		2F not spec	10 F	0 F not spec	15 F	10 F	0 F not spec
Calibration temperature (deg F)	Max.	550	400	400	300	350	500
	Min.	—20	—20	—20	—20	—20	—20
Maximum thermal range (deg F)		600	200	500	—	—	500
Minimum calibration tolerance (deg F)		5 F	10 F	5 F no load	5 F	5 F	10 F
Adjustable or non-adjustable		both	both	both	non adj.	non adj.	both
Snap acting or creep type contacts		creep	snap	creep	snap	snap	creep
Switching arrangements		SPST	SPST, SPDT manual reset	SPST	SPST	SPST manual reset	SPST
Hermetic seal		no	no	no	yes	yes	no



2. a, b and c. From left: snap acting type, current carrying bimetal creep type, positive acting creep type.

contact service life but also enables it satisfactorily to operate relays and solenoids, providing there is little or no vibration present in the parent machine and that the bimetal is exposed to relatively rapid temperature rise and fall.

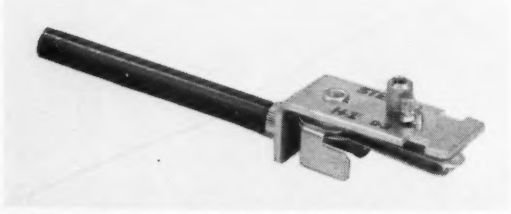
Through construction, the bimetal in this type of thermostat is placed in direct contact (through a nickel plated steel pad) with the surface on which the thermostat is mounted. Since the bimetal itself is a relatively low mass item of good heat conductivity, this direct heat conducting path makes the thermostat extremely responsive to any thermal changes that take place in the material or mass on which it is mounted.



3. Left and centre front: hermetically sealed ½-in disc type. Right: non-hermetic type. Rear: 1-in thermostat.

For this reason this type of thermostat provides excellent control in almost every aluminum cast-in element type application. In these applications the heat rise is usually rapid and produces some temperature overshoot that tends to open the contacts slightly more than necessary, allowing them a chance to cool off between operations, which adds measurably to their life expectancy.

It is noteworthy that in these thermostats the bimetal is completely independent of the electrical circuit. This eliminates any internal heating in it and allows the thermostat to sense only the heat it is intended to control. This means that the contacts will open only when necessary, further insuring a maximum useful contact life.



4. The probe thermostat is an ideal type for modern immersible kitchen appliances (such as a frying pan).

Again, although this is a control whose main ability is to sense conducted heat, its long active bimetal does a notable job in sensing air temperatures, so that it is now extensively used as a temperature control in window ventilating fans. It has also been used as both blower and heater control in room heaters, temperature control of low wattage water tanks and with secondary insulation is seeing electric range use at 230 volts. The most versatile of thermostats, it has often been called the work horse of the industry.

Snap-acting, bimetal leaf type

The interchangeable twin to this thermostat is the snap acting bimetal leaf type, shown in Fig. 2 (c). This control behaves exactly like the one described in Fig. 2 (a) except that it has a wider temperature differential because of its snap acting contacts.

In this unit the differential is a separate adjustment and hence can be set at the factory to customer specification. Typical differentials range from 15 to 100 F.

The other advantage of this unit is its adjustability. It can be supplied with thermal ranges up to about 400 F with a maximum calibration temperature of 400 F. Because of this adjustability, the unit can be used in percolators with flavor selection, portable room heaters, fans, melting pots and so forth.

The fact that, in the current-carrying bimetal leaf type of thermostat (Fig. 2 (b)), the bimetal carries the circuit current, requires extra consideration when contemplating its use. In the first place, since the bimetal is electrically energized, it cannot be in direct contact with any metallic surface. Conducted heat, therefore, will be at a minimum and the unit will lag on reception of such heat, possibly being even more susceptible to other forms of heat transfer.

The second consideration, of course, is how much heat will the circuit current develop in the bimetal and how will this affect the operation of the thermostat and hence that of the parent machine. Many applications cannot tolerate the inherent thermal lag of the isolated bimetal or its current additive heat. In others (such as motor protection) this additive current heat is advantageous in protecting against motor burnout from the high current condition of a stalled rotor. In cases such as this, either ambient heat or high currents can operate the thermostat.

On the other hand, this type of thermostat has creep type contacts with no temperature differential. Thus, as soon as the contacts open and the internal current heat is lost, if there is not enough residual heat present, the contacts will almost immediately close again. They will then continue to open and close as long as the thermostat circuit is energized or until the residual heat exceeds the calibration temperature.

This cycling type of operation is actually advantageous in some applications in which the thermostat is employed to allow constant current flow up to a certain temperature where it then begins to cycle and thus proportion the power to the circuit. This principle has been put to use in some percolators and allows the use of a single element heating unit instead of the usual two.

If the units are used as cycling controls, it must be borne in mind that they can cycle up to about 45 times per minute, which means a proportionately shorter contact life and is the worst possible condition for producing radio and TV interference. When cycling,

the contacts will run hotter than normal and their wear, over long periods, will gradually tend to lower the calibration of the thermostat. Under relatively heavy loads, there is a tendency for the contacts to weld together on some cycles, causing slight erratic operation, especially if the thermostat is being used to control a temperature.

Bimetal disc thermostats (Fig. 3 and Box) all have snap acting contacts and are generally available in the two sizes shown, the small ½ in. diameter disc and the large 1 in. diameter disc. They are available both as automatic resetting units for controlling temperatures and in the larger sizes, as manually resettable units for over-heat protection.

Both the small and large units operate on the same principle, whereby a temperature change causes the bimetal disc to snap over centre, like the action of an oil can bottom. As it snaps through centre, the disc depresses or releases a plunger which opens or closes the contacts.

Since the thermostats are snap acting and of bimetal construction, narrow temperature differentials are difficult to obtain. Hence the ½ in. diameter units can be made with a minimum 15 F average differential. The larger size, having more bimetal with which to work, can be supplied with a minimum 10F average temperature differential. In both units the larger the average differential, the lower the cost. A 50F average differential (or greater) carries the lowest price tag.

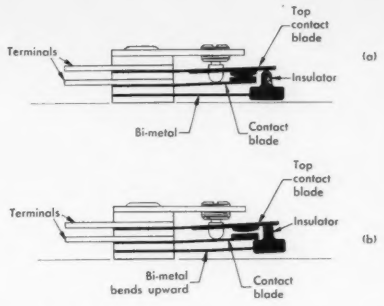
The different styles available

Both sizes of thermostat can be obtained in three styles. One style uses an exposed bimetal disc that affords maximum thermal response in air applications, such as fan controls and high limit controls in furnaces. The second uses an enclosed disc that provides adequate thermal response, plus protection from contaminated atmospheres, such as in clothes dryer exhausts which contain lint and moisture. In extremely wet or corrosive atmospheres, the third style (hermetically sealed) is available.

In the non-hermetic types, two styles of mounting are available. One is the protrusion type, in which the bimetal disc end of the thermostat extends about ½ in. through the mounting wall for better thermal response. This style is used mainly in air ducts; again as in furnaces and clothes dryers. The other style is called a flush mount and these thermostats can be mounted flush against a wall, on the other side of which is the mass whose temperature is to be controlled. Such an application is the automatic percolator.

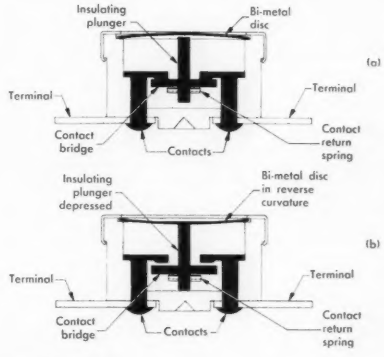
In both the hermetically sealed and in the open types the bimetal disc is a very low mass conductive element and is placed in direct conducting contact with the metallic case of the thermostat. For this reason this type of thermostat also produces excellent thermal response whether suspended in air or mounted directly on a surface using a flush mount construction.

In addition, the bimetals in these units do not carry current and are actually isolated from the current carrying members of the thermostat and thus internal heat is not a problem. As motor protectors, these disc units are constructed with a small heater under the bimetal disc. Wired into the motor circuit, the heater develops excessive heat only under abnormally large current conditions, such as occurs in stalled rotors. It is this extra heat that trips the thermostat to prevent



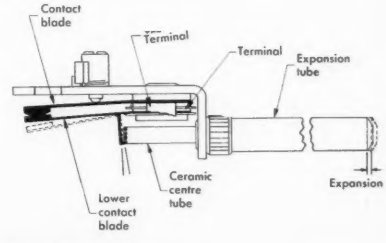
Bimetal leaf type

In view (a), the thermostat is shown at room temperature with the contacts closed. As heat reaches the bimetal it bends upward, causing the insulator to push against the top contact blade which opens the contacts, as in view (b). The friction and movement between the insulator and the top contact blade produces positive opening and closing of the contacts and results in long contact life.



Bimetal disc type

View (a) shows the thermostat at room temperature with the bimetal free of the insulating plunger and the contact bridge held against the contacts by the contact return spring. When the bimetal reaches its calibrated temperature, it snaps instantaneously into reverse curvature, depressing the plunger which moves the contact bridge off the contacts, as shown at (b).



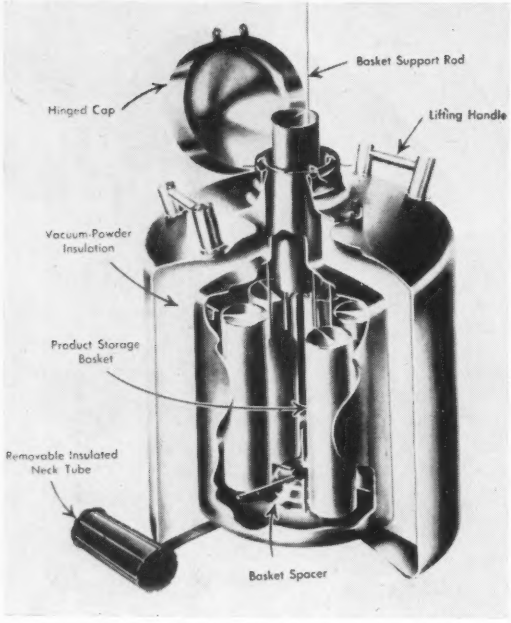
Expanding probe type

The solid lines show the thermostat at room temperature in the closed contact position. As the heat-sensitive expansion tube heats up, it expands and becomes longer (as shown by the dotted lines on the right). The ceramic centre tube (which extends the length of the probe) does not expand. Because the lower contact blade is spring-biased down, it follows the lengthening of the expansion tube as transmitted through the ceramic tube.

Continued on page 70

Ideas round-up

Portable refrigerators



A cross-section of the liquid nitrogen refrigerator.

The rapidly expanding field of cryogenics (the science of cold) now has a remarkable new tool. Linde Air Products Company announces a portable liquid nitrogen refrigerator for use in science and industry.

Linde believes that the new refrigerator (the LNR-25B) will find immediate use in such fields and industries as metalworking; electronics and agriculture; medical and pharmaceutical research; storage and transportation; chemical laboratories and plants; food processing.

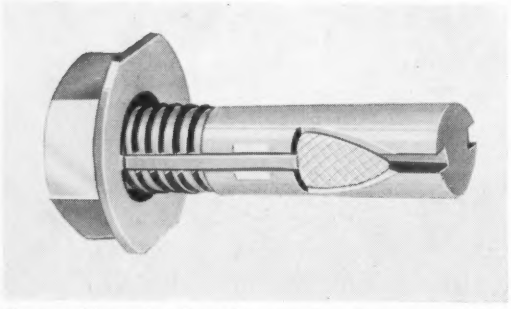
The new container was not offered to industry until it had been through years of development testing. It was, in fact, field-tested for for more than two years by the American Breeders Service of Chicago. It was found to be economical, durable and practical.

Here's how it works: A double-wall (container within a container) jacket of Heliarc welded stainless steel is insulated by a Linde developed vacuum-powder combination. The inner container is filled with liquid nitrogen at a temperature of —320 F. Accessory storage baskets filled with material for freezing or cold storage are lowered into the liquid nitrogen.

The LNR-25B will then hold material at a constant temperature of —320 F as long as liquid nitrogen, in any quantity, is present. A single charge will hold up to 34 days.

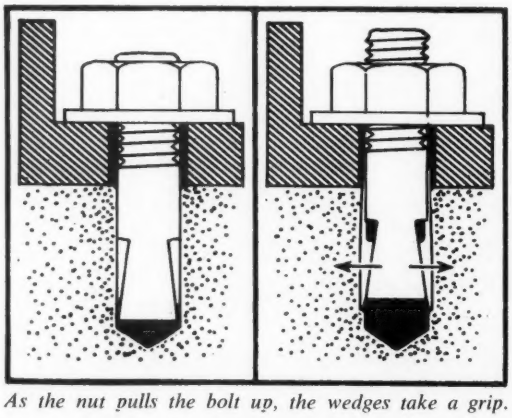
Since the new unit weighs only 115 lb fully charged (60 lb empty), it can easily be transported, even in the trunk of a car. Its independence of sources of power means complete mobility and security from losses due to equipment failure. (208)

Expansion bolts



One waffle-surfaced wedge can be clearly seen here.

A one-piece, one-sized hole, expansion bolt has been developed by Kirel, Inc., to simplify fastening (or anchoring) equipment, machinery or structural members in construction materials such as concrete, steel, cement or cinder blocks, brick, tile, plastic, and so forth. Called WEJ-IT, it is exactly what its name implies. The bolt expands as it is tightened, making a perfect anchor without separate sleeves, butterfly ends or other mating parts.



As the nut pulls the bolt up, the wedges take a grip.

It is extremely easy to install, requires no special tools and any piece can be anchored to the main structure without removing from position.

Available in all ferrous and non-ferrous metals, it is stocked in a wide variety of sizes carrying working loads from 200 to 1,000 lb. Standard diameters run from ¼ to ¾ in., lengths from 1⅜ in. to 3 in. Other diameters, lengths and working loads are available on special order. (209)

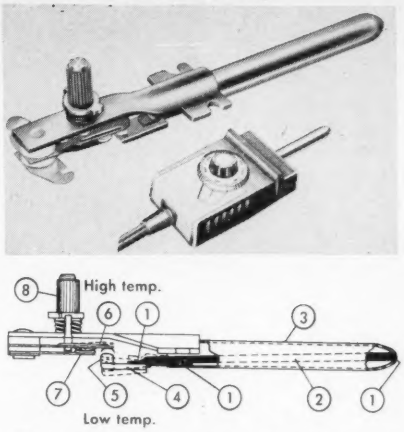
Tube and rod thermostats

With the new adjustable and highly sensitive Ampli-TUBE rod and tube thermostat (introduced by the Spencer Thermostat Division of Metals & Controls Corporation), it is possible for one thermostat to control temperatures accurately when used with different totally submersible appliances such as fry pans, saucepans, griddles and Dutch ovens.

The amplification of the difference in the high expansion tube and low expansion rod operates the ¾-oz thermostat by a push-pull switching action in a 150 to 420 F range. Rated at 1,650 watts, resistive, 120/240 VAC, the C9192 series thermostat has a welded construction which eliminates friction, wearing surfaces and loose mechanical linkages. It follows rapid temperature changes with little lag or override.

It is supplied with or without a cord set and plug assembly to enclose the thermostat. The plug assembly is factory adjusted to a manufacturer's product line and can be used interchangeably to control every submersible appliance within that product line. The assembly includes a setting dial and neon indicating light. (210)

The Inside Story



1. Weld: 2. Low expansion rod: 3. High expansion tube: 4. Actuating arm: 5. Ceramic insulator: 6. Movable contact arm: 7. Adjustable contact arm: 8. Adjusting screw: pushpull action of rod gives an amplified actuator motion.

Ceramic magnets

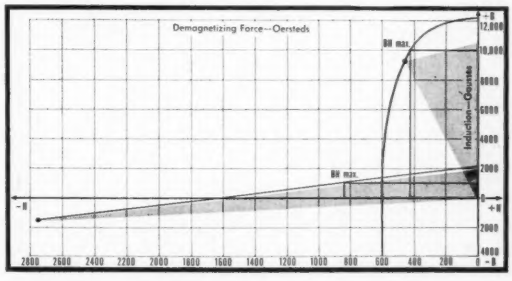
Ceramic permanent magnets can now be used in place of electromagnets for dc motor fields, it has been revealed by engineering and research heads of the Indiana Steel Products Company. The recent introduction of Indox V ceramic permanent magnets (see Design Engineering, September 1957, page 57) has made this possible.

Apart from the reduced cost, there are other advantages of using permanent magnets instead of copper wound electromagnets for dc motor fields. These are: higher efficiency, cooler operation, simplified motor design and lower fabricating cost. Indox V, the strongest ceramic magnet material available today, is suitable for a wide range of sizes, from 1/25 hp to 10 hp or more. Indox I is especially suitable for smaller motors, from 1/5 hp downward.

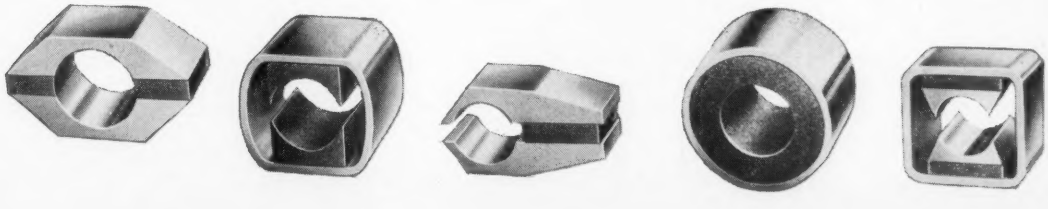
Questions have been raised about the use of the new ceramic materials for motors, since they have a somewhat lower rating than Alnico by the customary energy product (BH_{max}) method of measuring magnetic strength. This measure alone is, however, not suitable for comparing the usable energy of permanent magnets in nonstatic applications.

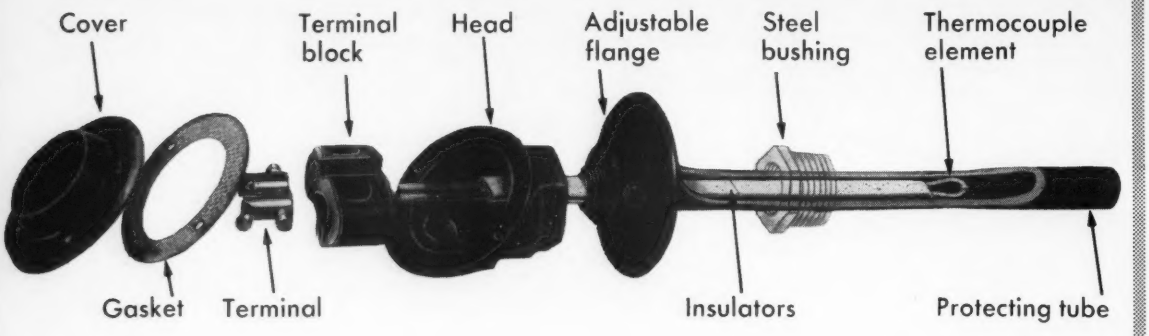
G. R. Hennig, senior design engineer at Indiana Steel Products, explained this very well in a recent paper. "In motors, generators and other applications where the magnet is subject to strong demagnetizing forces, the energy product is not the most significant consideration. One must consider the incremental permeability, even in the third quadrant of the hysteresis loop." (See curves.)

"The true measure is usable energy. Under such conditions, measured in the extreme, Indox I (according to work done by Richard Scholten) has a maximum energy of 17.4 in.lb per lb, while Alnico V (the strongest of the group) has only 13.7 in.lb. per lb. (211)



Composite of demagnitization curves shows that for Alnico V (upper) and Indox 1 (lower) operation in the third quadrant is produced when a demagnetizing force (stronger than the magnet) forces flux in a direction opposite normal operation, providing negative magnetic induction. The Indox magnetic flux will return to its full value once again when this force is removed.





How thermocouples take a temperature

Here are the basic laws governing thermocouples from the point of view of their practical application

Although thermocouples are used in thousands of applications for the measurement of temperatures ranging from about minus 300 F to upward of 3,000 F, the basic principles governing their operation are seldom completely understood. This article discusses several basic laws governing thermocouples from the standpoint of their practical application.

A thermocouple is simply two lengths of wire, made from different homogeneous metals, connected at both ends to form a complete electric circuit (see Fig. 1). This circuit develops an electromotive force (emf) when one junction is at a different temperature than the other.

This emf is dependent upon the difference in temperature between the hotter end (commonly termed the measuring junction) and the cooler end (commonly termed the reference junction) and the metallurgical composition of the two wires. However, several thermoelectric laws affect both the development and use of the emf produced.

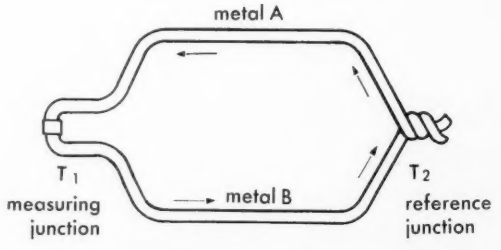
The emf developed in a thermoelectric circuit is ascribed to two phenomena, one known as the Peltier effect, the other as the Thomson effect. The Peltier effect governs the emf resulting solely from the contact of two dissimilar metals. (Its magnitude varies however with the temperature at the point of contact.) The emf resulting from the less predominant Thomson effect is that produced by a temperature gradient along a single wire.

Since there are two points of contact and two wires with temperature gradients it follows that there are two Peltier emf's and two Thomson emf's. The total emf acting in the circuit is the result of all four, with polarity being determined by the particular materials used and by the relationship of the temperatures at the two junctions. This emf can be measured by connecting a potentiometer (or other instrument for measuring emf) into the circuit at any point.

Commercial thermocouples generate about 20 to 50 millivolts through the range of their ordinary operating temperatures.

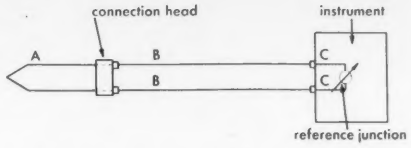
Since the materials used for commercial thermocouples are selected so that the Thomson effect can be disregarded, the total emf becomes the sum of the two generated by the Peltier effect. If the temperature at one junction (the reference junction) is kept constant (or if its emf generations are compensated for), the effective emf of the thermocouple becomes that generated by changes in temperature at the uncompensated or measuring junction. This emf is used to measure a temperature change.

An elementary thermoelectric pyrometer system is shown in Fig. 2. The instrument is usually located away



1. The thermocouple is two lengths of wire connected at both ends to form a complete electrical circuit.

Based on a series of articles that appeared in Instrumentation Magazine, published by the Industrial Division of Minneapolis-Honeywell Regulator Company. Reprints of the series can be had free from Honeywell Controls Ltd.



2. In reality, every thermoelectric system consists of three separate thermocouples: the thermocouple proper, A; the external lead wires, BB and the internal leads, CC.

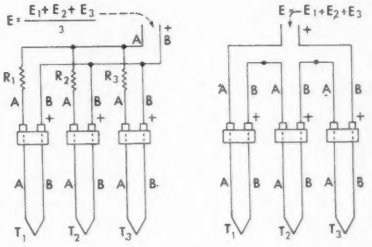
from the point at which the temperature is measured. Since the temperature-sensing resistor for maintaining a constant reference junction emf can be most conveniently located in the instrument as a part of its circuit, it is necessary to locate the reference junction itself in the instrument. The thermoelectric circuit must therefore be extended from the measuring junction (at the point where the temperature measurement is desired), to the reference junction in the instrument. This is done through the use of extension wires as explained below.

Because the thermocouple assembly is exposed to elevated temperatures and adverse atmospheric conditions, it is an expendable unit and must be replaced periodically. To do this, a terminal head is supplied, to which wires known as extension wires are connected. Since these wires are in the thermoelectric circuit, they must be made of the same material as the thermocouple assembly, or materials having essentially the same temperature—emf curve.

The actual reference junction is inside the instrument, so internal extension wires of these same materials must be used between the instrument terminals and the reference junction. Therefore, there are really three thermocouples in the circuit: one in the thermocouple assembly, one in the external extension wire and one in the internal extension wire. But the actual temperature at the connecting head and at the terminals of the instrument has no influence, since the Law of Intermediate Temperature states that the net effect of the three thermocouples is the same as if one thermocouple ran from the measuring junction to the reference junction. These three components of the thermoelectric circuit are usually present.

Thermocouples can be used for temperature measurements other than at a single specific point. Also, several variations in the use of interconnected thermocouples are possible. Two of these find ready application in the measurement of differential and average temperatures.

Since the thermocouple develops an emf which is a function of temperature difference, it is easily applied to the measurement of the differential temperatures encountered in many industrial processes, such as the checker work of an open hearth furnace. Shown in Fig. 3 is a practical arrangement for measuring such temperatures. Two similar thermocouples (C and D) are connected together with extension wire of the same materials as those used in the thermocouples. The connections are made in such a way that the emf's developed oppose each other. At point E, two leads are run to the instrument. This circuit is essentially the same as an elementary thermocouple circuit and so the emf developed at E will be proportional to the difference between the temperatures and T_1 and T_2.

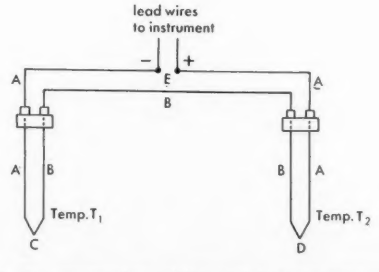


4a & b. Measurement of average temperature with thermocouples in parallel and series.

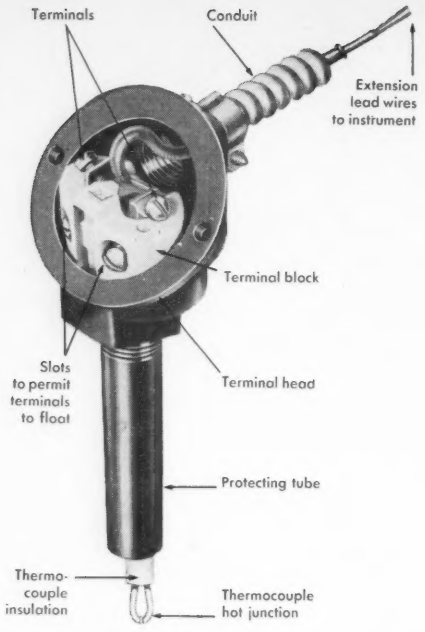
Sometimes we want to measure the average temperature in large ducts or other apparatus. Thermocouples can easily be used, for they can be connected either in parallel, or in series, in the same manner that primary cells are interconnected.

Typical parallel and series thermocouple units are illustrated in Fig. 4. In Fig. 4(a) the emf developed (E) is the average of that developed by the three thermocouples shown. To obtain a true average, the temperature-emf curves of the three thermocouples must be linear, which is seldom actually the case. However, this condition can be approximated.

Since current will circulate among the three thermocouples when the temperatures T_1, T_2 and T_3 are not equal, the resistance in each individual thermocouple circuit beyond the point of parallel connection must be equalized by swamping resistors R_1, R_2 and R_3. This is done because the voltage E is the average of the potential drops across each individual branch of the circuit, rather than an average of the electromotive forces. Since the resistance of the actual thermocouple



3. In measuring differential temperatures connections are made so emf's are opposed.



5. Thermocouple assembly, terminal head cover removed

will also vary with its temperature, this variation must be minimized by making the values of R_1, R_2 and R_3 high in comparison with the change in resistance that is encountered.

Parallel connection of thermocouples for average temperature measurement is helpful because the instrument calibration can be the same as that for a single thermocouple. However, if any one of the thermocouples burns out, the failure cannot be quickly detected.

Fig. 4 (b) shows the series connection for averaging temperatures. Each of the thermocouples is connected in series with the others, using the correct extension wire materials. Where three thermocouples are used, the emf developed (E) is approximately three times that developed by one of the thermocouples. In this arrangement, the instrument calibration does the averaging.

If a null-balance type of instrument is used to measure the emf, it is not necessary to equalize the resistance in each branch of the circuit as with parallel connections. The extension wires from each thermocouple, however, must be extended back to the actual reference junction if precise results are desired.

Instruments used with this type of circuit must be calibrated for three times the emf of one thermocouple, assuming that three thermocouples are used. Here, if one thermocouple burns out, it is immediately detected since the emf E disappears.

The series thermocouple circuit is also frequently used to get greater emf output or more sensitivity with an instrument when very small temperature changes must be measured. Also, the series connection is used in a thermopile, employed in such devices as the radiation pyrometer. In this device, the amount of radiant energy reaching the junctions is very small. Therefore, some means for increasing its effect is needed.

When using either parallel or series type averaging circuits, it is important to avoid grounded measuring junctions, since such grounds will result in circulating currents between the individual thermocouples and this will affect the emf at the instrument connections.

To meet the accuracy requirements of different thermocouple applications, most manufacturers offer two basic grades of wire and thermocouples: (1) Regular (or standard) and (2) Special grade. Regular Grade wire follows the standard temperature-emf curve very closely and is suitable for most industrial applications. If required, thermocouples (or a representative thermocouple made from a quantity of the wire) can be furnished to the customer, accompanied by an error curve giving the deviation and the standard calibration at specific temperatures.

Special grade wire is especially selected to follow the standard calibration curve more closely and is used where greater accuracy is desired. Its cost is slightly greater than that of Regular grade wire.

Connection Head

The thermocouple connection head is an important component of the thermoelectric pyrometer system. Proper attention to this element will contribute both to over-all measuring accuracy and ease of installation and maintenance. Fig. 5 illustrates a typical general purpose head.

The purpose of the thermocouple connection head is two-fold. First, it provides for electrical connections to the thermocouple wires and the extension wires; second, it provides a means for attaching a protecting

Common types of thermocouple

The five most commonly used types are:

Base Metal Thermocouples

(1) Copper-Constantan (Type T)

(2) Iron-Constantan (Type J)

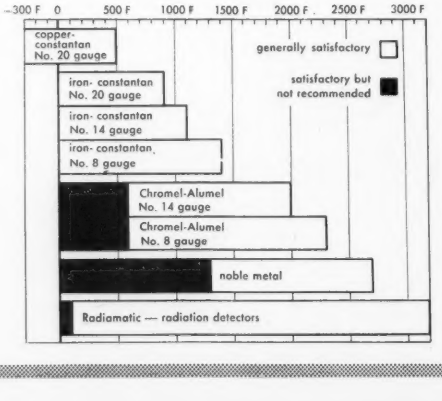
(3) Chromel-Alumel (Type K)

Noble Metal Thermocouples

(4) Platinum—13% Rhodium Platinum (Type R)

(5) Platinum—10% Rhodium Platinum (Type S).

The type letters in parenthesis after each are the letter symbols adopted by the ISA in 1948. The useful temperature range of these thermocouples is given in chart from below.



tube and an extension wire conduit. These two purposes are important in most applications where it may be necessary to replace the thermocouple and its protecting tube a number of times during the life of the installation.

As shown in Fig. 5, a ceramic terminal block within the head contains metal terminals to which the thermocouple and extension wires are attached. These terminals are relatively large so that temperature differences between the two connections are small. If this isn't done, a temperature difference might introduce a parasitic voltage which would affect the over-all accuracy of the couple.

Although the general purpose head is provided with a gasketed cover which can be tightly fastened, the screw cover type of design is preferable for outside applications where the head must be completely weatherproof. The screw cover type uses the same terminal block as the other type of head but can be provided with other interchangeable types such as a block for duplex thermocouples. Since the head must be opened from time to time, screw threads are used on the inside of the cover to minimize "freezing" of the cover to the base.

Most connection heads have terminal blocks that accommodate various sizes of thermocouple and extension wires. Raised letters molded into the ceramic block (which identify thermocouple polarity and type) help assure proper connection of the positive and negative extension wires.

Extension Wire

Extension wire is generally furnished as a matched pair of conductors with an insulation designed to meet the service needs of a particular installation.

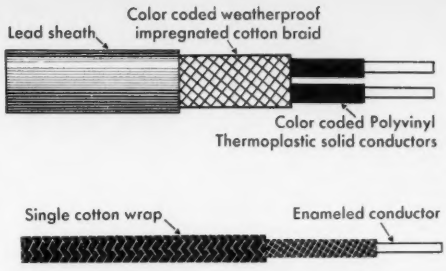
The simplest procedure for extension wire would be to use the same types of wire that make up the thermocouple. In actual practice, however, where several hundred feet of extension wire must be run from a couple (and where numerous couples are used) this becomes relatively expensive with Chromel-Alumel and prohibitively expensive with platinum, platinum-rhodium couples. In such cases, lower-cost extension wire is available.

Whenever practical, extension wire should be run in a conduit and protected from excessive heat, moisture, mechanical damage and electrical interference. Because of the variety of conditions under which extension wire may be used, there are a number of different types of insulation. In addition to their basic function of electrical insulation, the wire coverings may be required to serve as physical protection under conditions of extreme weather and moisture, yet preserve their color coding. The following types of insulation are some of the more common ones available:

Polyvinyl plastic. This insulation represents a definite advance in pyrometry. The synthetic plastic coating retains its color coding and has a high resistance to most alkalis, acids, alcohols, gasoline, greases and oils. The plastic coated wires are covered with an over-all plastic jacket (Fig. 6).

Polyvinyl plastic insulation is suited for ambient temperatures up to 220 F. It is smaller over-all than other types so that more wires with this type of insulation can be run in a conduit as compared with other.

Asbestos-covered wire. This wire is suitable for temperatures between 220 F and 400 F. Because asbestos is hygroscopic, individual wires are first enamel coated. The color-coded felted asbestos is impregnated with a flame-and-moisture-resisting compound and covered over-all with color-coded asbestos braid.



6. Lead sheath over polyvinyl makes a very rugged combination when conduit's not used.

Lead-sheath wire. A protective lead sheath over the polyvinyl plastic extension wire as shown in Fig. 6 makes a very rugged combination where conduit is not employed. At the same time it provides resistance to moisture and to many corrosive atmospheres.

Rubber-jacketed stranded wire. This wire is made with stranded conductors for greater flexibility, and is primarily employed for portable use. With rubber-covered individual conductors and a rubber jacket over-all it is, of course, moisture resistant but is not recommended for use at temperatures exceeding 140 F. With certain wires, synthetic rubber (such as Buna-N) can be supplied to give better resistance to certain chemicals and oils.

Protecting tubes and wells. With very few exceptions, thermocouples must be equipped with suitable protection in the form of wells or tubes, particularly at high temperatures. The term **protecting tube** refers to a closed-end tube attached to the connection head (as shown in Fig. 5). A **well** is a pressure tight receptacle with external threads for attachment to a vessel or pipe line.

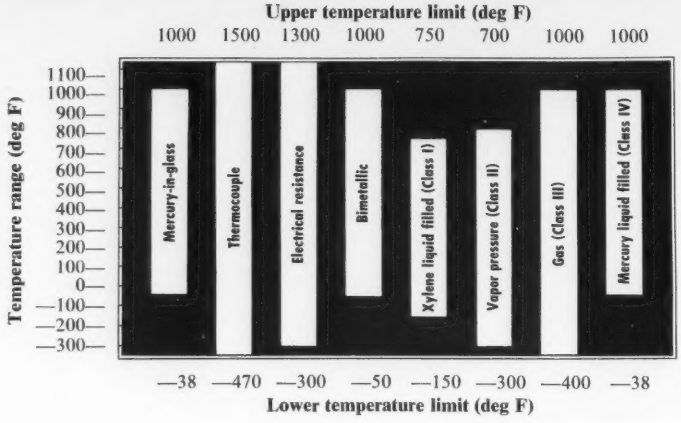
Hundreds of varieties of these tubes and wells in various metals, alloys and refractory materials are on the market today to meet special job requirements.

In the past ten years the metals and ceramic industries have made great advances in the development of special alloys and refractory materials for tubes and noble metal (platinum content) couples are used with ceramic protecting tubes.

Thermocouple Response

As previously mentioned the use of an enclosure over a thermocouple hinders ideal measurement and control. Speed of response (the rate at which the thermocouple detects temperature changes) is of vital concern in many applications, particularly where these changes occur rapidly. Many factors of heat transfer affect the speed of response of a thermocouple Among the most important of these are (1) the mass of the couple and (2) the air gap between the protecting tube and the couple.

The smaller the mass of the couple the faster its response. Since a bare couple is smaller than the same couple in a protecting tube, it is best from this viewpoint, but is impractical in a great many cases. ★



The devices for measuring temperature

An outline of the five measuring devices that are most commonly used

By W. J. Stauss

The temperature measuring instruments usually used in industrial laboratories are in the thermometer class. These have their temperature-sensitive elements in contact with the area (or point) where the temperature is wanted, as opposed to instruments (like the optical pyrometer) that function at a distance from the object whose temperature is required.

There are also some means of measuring temperatures that can be used only once: materials, for example, that change color at certain temperatures or others that melt at particular temperatures. Such devices are in general not used to monitor temperatures of manufactured industrial equipment, for they only indicate when a particular temperature has been exceeded.

As an example of a thermometer selection problem, an engineer designing and testing an internal combustion engine requires temperature readings from the oil reservoir and cooling system during tests. Here the temperature levels are in themselves not critical, unless certain temperature limits are exceeded. In this case the engineer needs a device that has an accuracy no better than ± 5 (or even ± 10) degrees. More important than accuracy: the device should be easily read and rugged enough to withstand vibration during engine running tests.

If the engineer were to select a thermocouple for this test, it would serve the purpose very well; too well, in fact. Thermocouples have a much higher accuracy than is needed here and also provide remote indication, which is not necessary. These points by themselves should not, of course, rule out the use of a thermocouple. But when the cost of this type of instrument is compared with cheaper (but less accurate) instruments, it indicates the need for further consideration.

On the other hand, a relatively inexpensive mercury-in-glass thermometer would fit the needs, though special mounting devices may have to be incorporated to prevent the glass from breaking. These thermometers are also difficult to read from different positions. The designer would probably decide therefore that the best solution consists of inexpensive bimetallic thermometers, which in this case can be screwed directly into threaded holes in the oil sump and radiator or heat exchanger, without any special mounting equipment.

Any selection of thermometers may be simplified by following a similar analysis. However, most problems of thermometer selection will not be as simple as this example, but by following such a method, any necessary compromises will become immediately apparent, greatly aiding the choice of the least expensive and most efficient instrument for a specific application.

In general, there are four considerations that must be taken into account by the engineer before he can select the best thermometer. These are:

The methods used for the proper selection of temperature measuring devices are not standardized or well defined. Today, as temperature measurement becomes increasingly more critical, it is important that close attention be paid to the matter.

The almost endless list of temperature measuring devices available often makes it difficult for design and test engineers to choose the proper instrument for a specific application. With the qualitative and quantitative data presented in this article, the design engineer has a greatly simplified procedure for the most efficient selection of temperature measuring equipment. Five of the most commonly used measuring devices for both temporary and permanent test installations are outlined here, together with the most important functional and economic characteristics.

Table I. Ruggedness versus environment

Thermometer type	Overheating (50% scale)	Environmental Conditions Undercooling (50% scale)	Impact test (½ft. drop)	Continuous use (1 yr.)
(1) In-glass	C	B-C	C	B
(2) Thermocouple	A	A	C	A
(3) Electrical resistance	A	A	C	A
(4) Pressure actuated	B	A	B	B
(5) Bimetallic	A	A	A	B

A=Generally no effect
B=May affect accuracy, may need recalibration
C=Probably damaged instrument

Table II. Comparative costs

	Type of instrument	Relative cost
(1)	Mercury-in-glass	2-5
(2)	Thermocouple	10-100
(3)	Electrical resistance	10-100
(4)	Pressure actuated	5-10
(5)	Bimetallic	1

Note: Based on the cost of bimetallic thermometers being equal to one unit.

Choice of thermometer.
The graph (left) and tables (above) will provide a qualitative (as well as quantitative) indication of thermometer characteristics. They should prove extremely useful to the engineer interested in efficient (as well as effective) temperature indication. It is a known fact that when relatively unfamiliar personnel select a thermometer, they usually pick the most accurate instruments available, with no regard to actual accuracy required. With a brief step-by-step analysis of requirements in such a situation those selecting thermometers can save many dollars each year.

- temperature range
- accuracy required
- reliability and ruggedness
- cost

There is no completely automatic way of selecting a thermometer; unless the funds available for instruments are unlimited, certain compromises will have to be made. On the other hand, if a wide range of accuracy can be tolerated, instrument costs can often be extremely low.

The various characteristics of the most commonly used thermometers are outlined below. This (together with the comparisons given in Tables I and II) will aid in the selection of the proper instrument for a particular use.

The types of thermometer in general use in industry that give a direct reading include:
(1) Liquid-in-glass
(2) Thermocouples
(3) Electrical resistance
(4) Pressure-actuated
(5) Bimetallic strips and coils

Although there are many other techniques and devices used for temperature measurement, they are usually quite specialized and not classified with the ones used in general applications in industrial test equipment. They include optical or radiation pyrometers and pyrometric cones.

The following facts, concerning the characteristics of the various types of commonly used thermometer do not, of course, hold rigidly in all cases, since many new types of thermometer are coming into existence all the time. Also, special variations of these instruments can be designed for specific applications with somewhat differing characteristics. The following data are, however, considered representative of the different types of thermometer now in wide use.

(1) Liquid-in-glass thermometers

Using the thermal expansion characteristics of certain liquids, liquid-in-glass thermometers are available to cover limited temperature ranges within the over-all range of —170F to 1000F. The standard mercury thermometer (generally used in industrial work) is manufactured to include various ranges within the —38F to 1000F range with ±1% of span accuracy. However, when liquid-in-glass thermometers are used at temperatures above 300F, the glass has a tendency to distort, even if it has been properly treated during manufacture. Variations of this type with poor quality glass may be as high as 30F when the thermometer is heated to 500 or 600F for any length of time.

There are also some hysteresis effects in glass thermometers that occur with alternate heating and cooling due to the characteristics of the glass. However, with a good grade of glass, these effects can be disregarded for industrial applications. The primary disadvantage of in-glass thermometers is fragility. For this reason, they are not usually suitable for permanent installations. In-glass and bimetallic thermometers are the least expensive of the five types mentioned.

(2) Thermocouple thermometer

Thermocouple temperature measurements are based on the electrical potential variation that occurs when certain dissimilar metals (in contact) experience temperature changes. These potential variations are measured and calibrated to temperature measurements. Thermocouples for industrial use present some of the most accurate measurements, although by comparison with in-glass thermometer and bimetallic coils, for example, they are considerably more elaborate with regard to related equipment. Most temperature instruments for installation in industrial equipment do not require an accuracy greater than ±1 to ±5F degrees, which is provided by in-glass or bimetallic instruments. In order to make thermocouple measurements, it is necessary to have additional instrumentation including a voltage source, standard cell, potentiometer, galvanometer scale and resistor network. Thermocouple instruments are often portable for industrial use but require a certain amount of care in their handling and application.

Among the advantages of thermocouples is the fact that the actual temperature reading can be made at locations remote from the sensitive element. Thermocouple measurements are sometimes more convenient

to use when measurements must be taken in areas that cannot be reached except by flexible wires. As a further advantage, the same thermocouple indicating instrument can be used alternately to read temperatures from almost any number of individual elements covered by the range of the instrument. With this type of instrument, accuracies better than ±1% of scale reading are no great problem.

In special applications, thermocouples have been used in various ranges from near-absolute-zero to 5000F. Many different metals can be used for thermocouple elements. Temperature range will depend on the wire materials, wire thickness and instrumentation calibration. Thermocouple and electrical resistance thermometers are considerably more expensive than in-glass and bimetallic devices.

(3) Electrical resistance thermometers

Electrical resistance thermometers work on the changing resistance of an electrical conductor as the surrounding temperature varies. Like the thermocouple unit, this device requires special instrumentation. The instrumentation is needed for measuring resistance changes that are translated to a calibrated temperature scale. Electrical resistance thermometers are very accurate devices when used in conjunction with highly precise instrumentation of laboratory-standard quality. Accuracies higher than ±1% of scale reading are readily attained for industrial test installations. This temperature measuring device can also be used for remote indication of alternately sampled temperatures.

Resistive sensor elements are usually fabricated from platinum, nickel or copper. Platinum elements are used in the range of about 260F to 1300F; copper elements —40F to 250F; and nickel elements —300F to 600F. Within the range of platinum elements, resistance thermometers are considered more accurate than thermocouple devices. However, for high accuracy, extreme care is required in manufacturing the instrument and the sensing elements, which are not very rugged. Such equipment is generally not used in industrial applications. Instead more rugged, considerably less accurate instruments of this type are available.

(4) Pressure-actuated thermometers

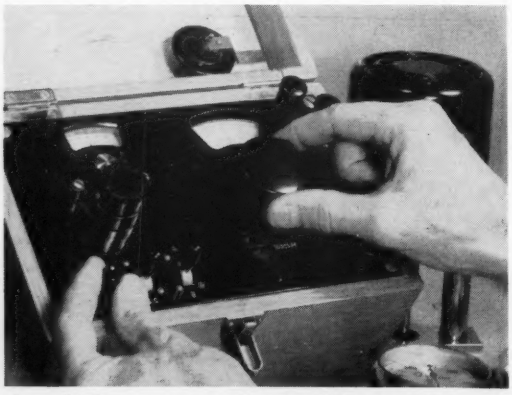
Pressure-actuated thermometers are made up of metal bulbs filled with materials that expand and contract under temperature change and usually exert a pressure on a Bourdon tube, spring or bellows (through a capillary tube) to indicate temperature measurements. This general type of thermometer has been classified (by the Scientific Apparatus Makers Association) into four categories:

Class I is a liquid-filled system (any liquid but mercury). This type of instrument generally has an upper limit of 750F.
Class II is a vapor-pressure thermometer. The range for this type of instrument is generally confined to a 200 or 300 degree span for any particular liquid within a range of —20F to 750F.
Class III is a gas-filled system that usually contains nitrogen. The temperature range of this type of instrument is —60F to 1000F.
Class IV is a variation of Class I containing mercury. This system is limited to 1200F measurements.

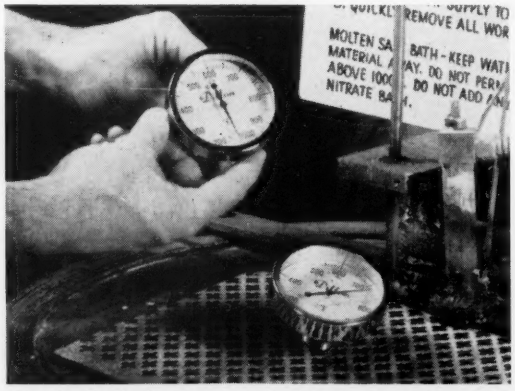
(5) Bimetallic thermometers

Bimetallic thermometers work on the differing thermal expansion of two pieces of joined metal. This bimetallic unit serves as the temperature sensitive element and temperature readings are directly indicated by the bending of joined pieces as one expands more than the other. This type of instrument is of metallic-self-contained, rugged construction, usually having a direct-reading pointer on a calibrated circular dial. To provide a very compact thermometer, the element is in the form of a helical coil. One end of the coil is held stationary and the other is attached directly to the pointer through an internal, rotatable shaft. Since temperature indication is not dependent on the length of this shaft, bimetallic thermometers can be obtained for almost any depth of submersion for special applications.

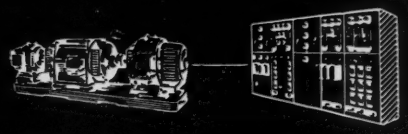
Bimetallic thermometers are constructed to cover various short ranges or the complete range between —40F and 1000F with accuracies of ±1%. ★



A multiple range potentiometer indicator being used to monitor temperature of various calibrating baths.



The final check of two typical instruments in a high temperature electrical bath having a 1000 F capacity.



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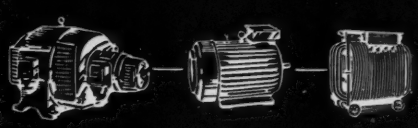

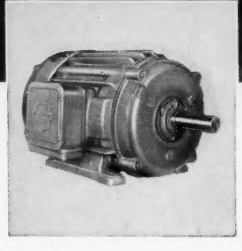

With 'Motors' too – skill is what makes the difference

The score, which specified the notes to be played, their speed and rhythm, is but a recipe for music. It is the pianist who makes the music great. His skill is something that cannot be learned from writing; it may be passed on to a brilliant pupil, but only through the keyboard, and only after long practice. Something almost as odd and subtle turns up in industry. We call it 'know-how', but it often seems as instinctive as a nervous reflex. It is the sum of countless difficulties overcome in the past, the solution to which is now taken for granted. It is the reason why there is a difference between one motor and another that meets the same specification. This difference is the result of years of experience that goes with a name that has a long history behind it.

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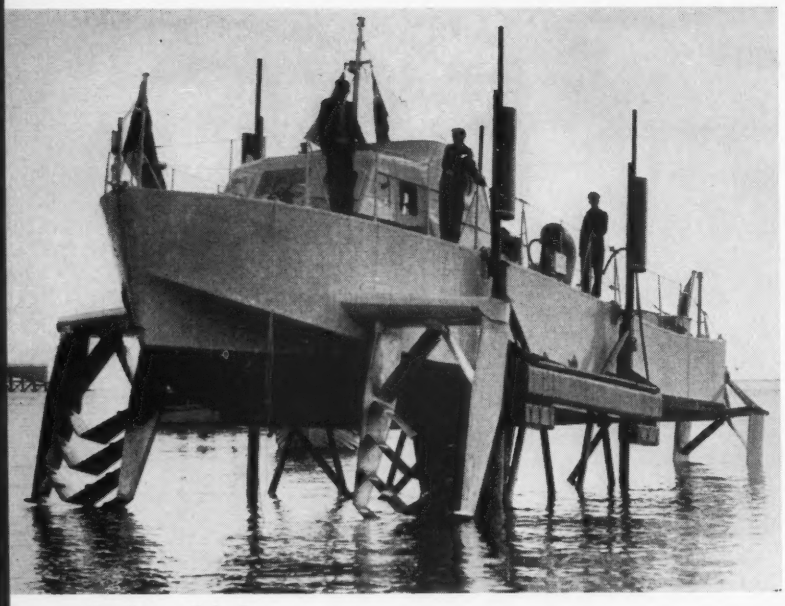
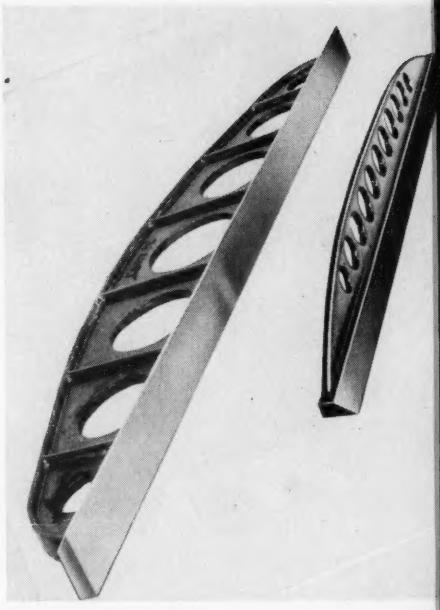


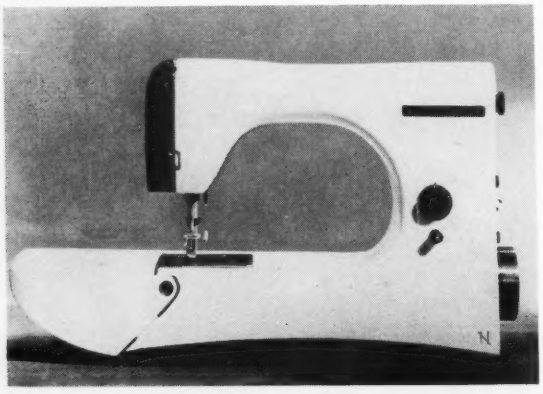
Boating or flying?

This is the Bras d'Or, named after the lakes where Alexander Graham Bell and Casey Baldwin first investigated the possibilities of hydrofoil craft around the turn of the century. It has aroused RCN interest as a rescue craft. (200)



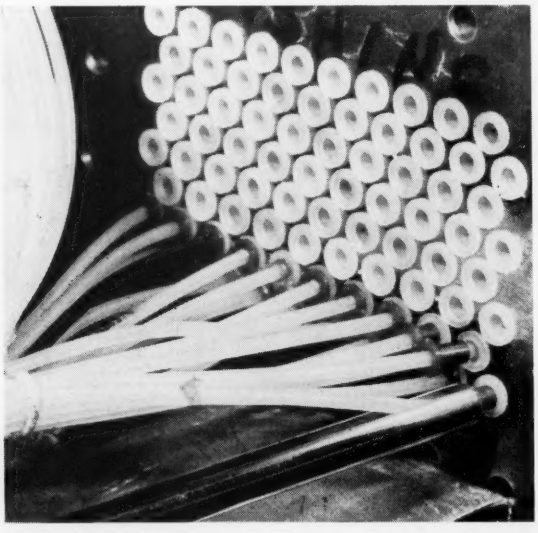
Getting things straight

These units are used to scrape the dovetails of machine tool beds to maintain accuracy in the machine. Of special steel, they are accurate to within .0002 in. (201)



Looks and a sewing machine

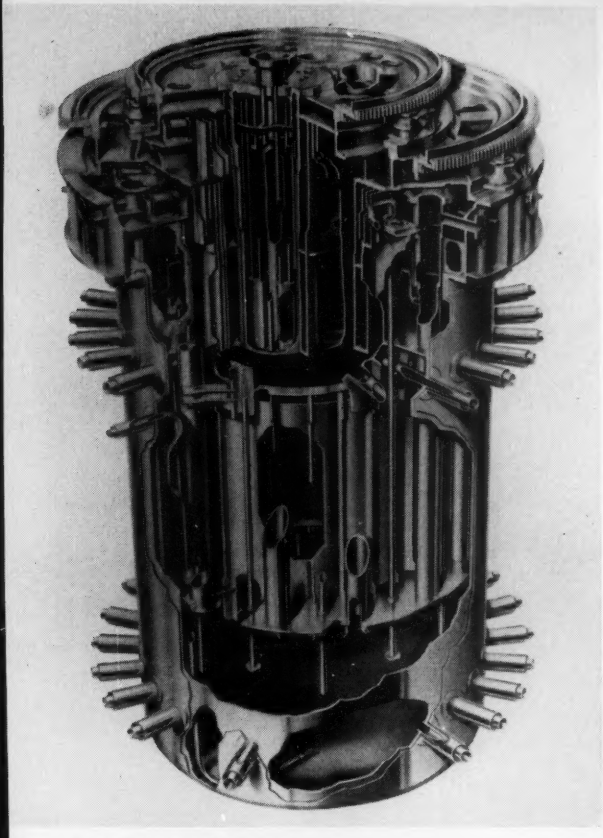
Prototype of Necchi's Mirella sewing machine. The arm encloses the complete mechanism and is made, together with the bed, from one casting of light alloy. The bed curves to balance the curve of the arm. (202)



Fast anchoring

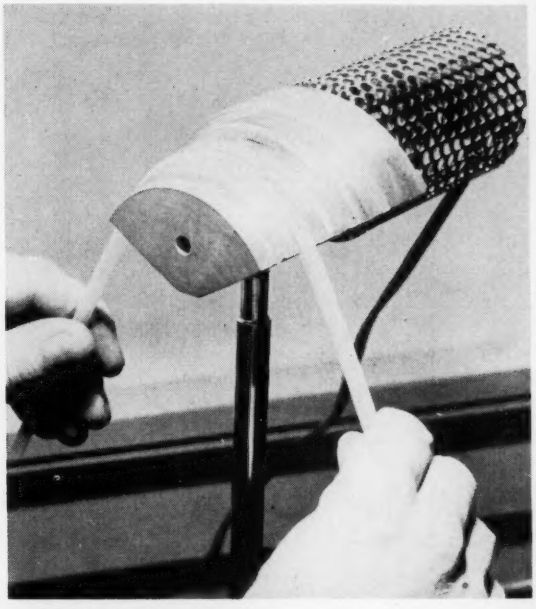
These nylon fittings provide a positive anchor in hydraulic and pneumatic applications using brass, copper, aluminum, steel or nylon tubing without distorting it. They'll stand up to 1,200 psi. (203)

Some modern designs making news today



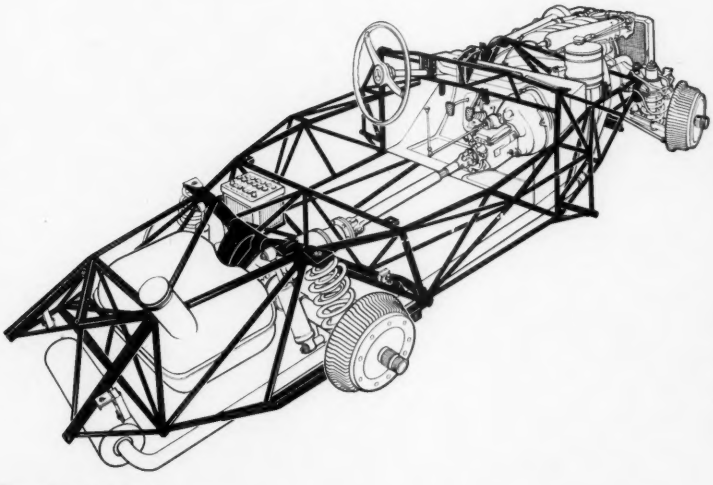
As complex as they come

The Dounreay reactor vessel is a complex 45-ton steel vessel with eccentric rotating top shields and will contain the core, breeder blanket, rod mechanisms, instruments and liquid metal for exchangers. (204)



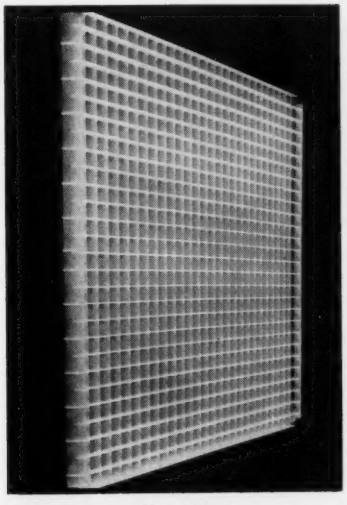
Putting the bends in tubing

Used for heat forming permanent bends in polyamide tubing, the Permabender has a heating element and mandrel with grooves to accommodate tubing sizes up to ⅜ in. OD. Ten to twenty seconds does the job. (205)



Race-bred chassis

The tubular steel chassis of Mercedes Benz 300SL sports cars bears the stamp of a carefully planned structure. The company claims that the tubing is stressed only longitudinally, rather a sweeping statement since the joints are not pin-jointed but are welded. (206)



Polystyrene in the ceiling

This paragrid tile features a bi-planar construction which results in excellent diffusion. Tiles are thoroughly de-staticised against dust. (207)

In Sand Castings, CSI place the accent on Sand

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Of course a wide variety of tests are also performed on the metals themselves as they pass through each stage of production—from the melt to the finished product. In addition to regular tensile and hardness testing procedures, the laboratory at Canadian Steel Improvement Limited is equipped to handle gravimetric, photometric, volumetric and spectrographic analyses as well. Competitors may feel that CSI are extremely "test-conscious", but the quality of their finished sand castings seems to prove that the extra effort is worthwhile.

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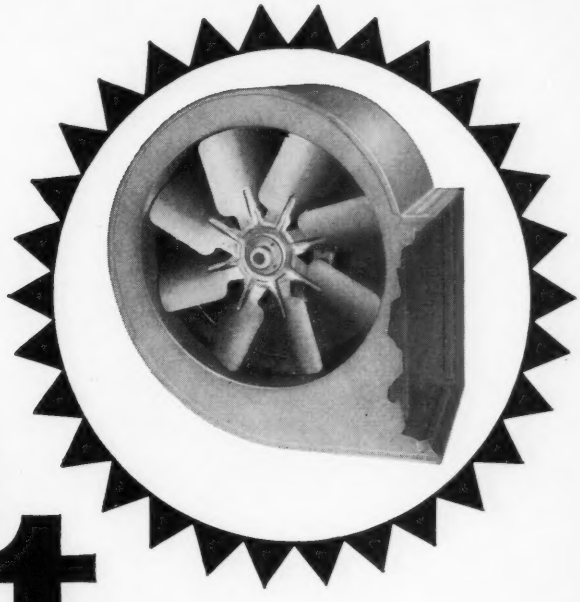
It is a direct drive mixed-flow unit employing an exclusive Torrington design concept which results in the conversion of axially-developed air pressure into a radial flow pattern.

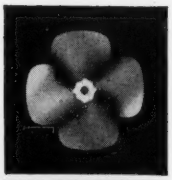
The result of this design breakthrough is a versatile unit that can be tailored to an extended range of customer needs by modification of the axial fan configuration to exact performance specifications. This eliminates dependence upon a variety of different sized units for varying requirements.

The RX offers three important advantages:

PERFORMANCE—A flat power curve makes it a non-overloading unit, permitting the use of a single smaller-capacity motor for varying applications, and availability of the unit in sizes heretofore too large for direct drive applications.



1st



CONSTRUCTION—A vertical center panel divides the unit longitudinally and supports the motor at its center of gravity. Resilient motor and fan mountings minimize noise and vibration. Result is quiet performance, and easy assembly and service.

ECONOMY—The basic design permits size reductions of as much as 36 per cent in the cubic dimensions of the unit, without sacrifice of performance. Thus, the RX is a thinner, more compact unit that can be fitted into tighter areas without choking of air intakes.

The design and performance of the RX give it a versatility that is of special importance to design engineers of air moving equipment. Full specifications are available.

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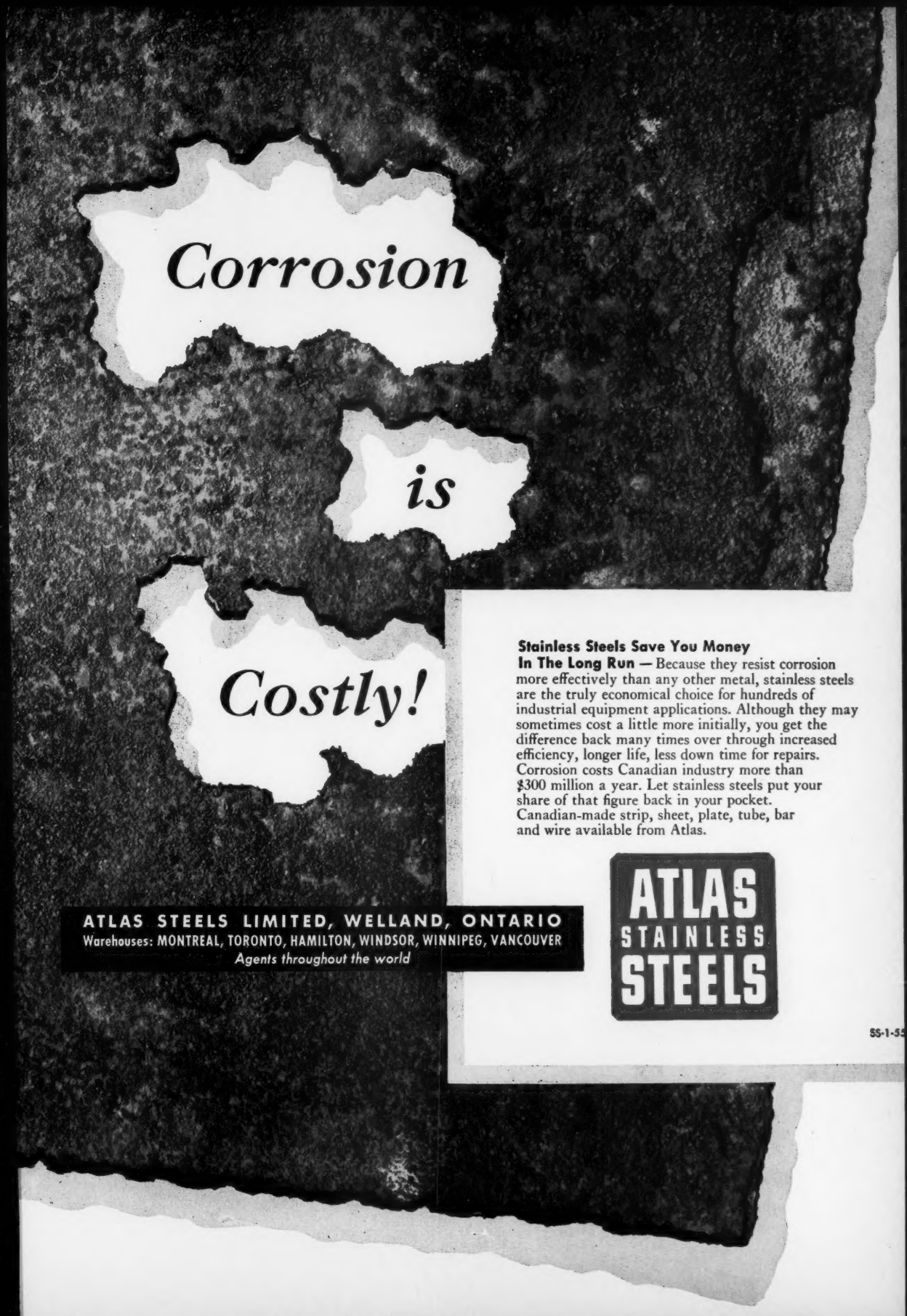
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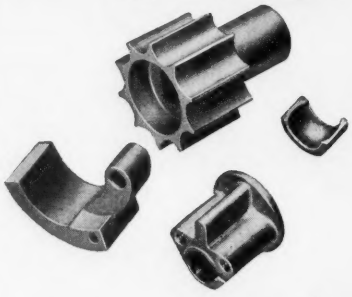
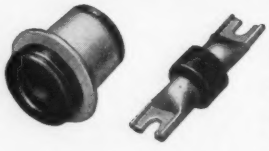
Costly!
Stainless Steels Save You Money In The Long Run — Because they resist corrosion more effectively than any other metal, stainless steels are the truly economical choice for hundreds of industrial equipment applications. Although they may sometimes cost a little more initially, you get the difference back many times over through increased efficiency, longer life, less down time for repairs. Corrosion costs Canadian industry more than $300 million a year. Let stainless steels put your share of that figure back in your pocket. Canadian-made strip, sheet, plate, tube, bar and wire available from Atlas.
ATLAS STEELS LIMITED, WELLAND, ONTARIO
Warehouses: MONTREAL, TORONTO, HAMILTON, WINDSOR, WINNIPEG, VANCOUVER
Agents throughout the world
ATLAS
STAINLESS
STEELS
SS-1-55

Clevite Limited,

Canada's only major manufacturer of sleeve-type bearings and bushings, also produces:

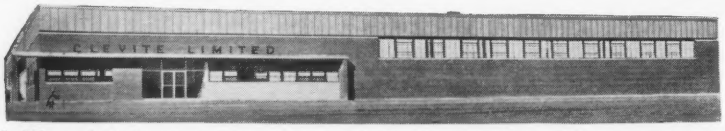


Powdered Metal bearings and other precision structural parts. Sintered or self-lubricating bearings are strong, quiet, absorb shock, permit greatly decreased clearances. Many other types of complicated precision, ferrous and non-ferrous parts can be made economically.



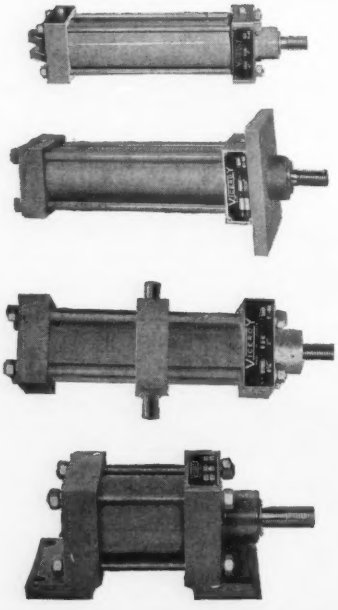
Rubber-and-Metal bearings. Silentbloc units provide oscillating motion, reduce noise, correct misalignment, provide torsional vibration in all types of machinery.

We are at your service. Write or call Clevite Limited, St. Thomas, Ontario



Canadian Subsidiary of Clevite Corporation, the World's Leading Producer of Sleeve Bearings and Bushings

VICEROY CYLINDERS



When you look at the finer points of construction that are so apparent in VICEROY cylinders, you will be convinced that for rugged, dependable service you should always choose **VICEROY.**

END CAPS: Solid or Welded Steel depending on diameter of bore.
CYLINDERS: BARREL DRAWN SEAMLESS BRASS TUBING. (Drawn Seamless steel tubing can be supplied if required and specified.)
PISTONS DURAL: For corrosion resistance and lightness.
PISTON RODS: Stainless Steel for added strength and corrosion resistance.
PISTON PACKINGS: Best Chrome Tanned Leather (or others materials most suitable for service specified.)
PACKING GLANDS: Chevron Type of grade suitable for service specified.
SPECIALS: Variations from standard cylinders can be supplied as specials and will be quoted on application.

CATALOGUE ON REQUEST

Engineering Division VICEROY *West Toronto Canada*
MANUFACTURING COMPANY LIMITED

The experts agree on

DOFASCO satincoat

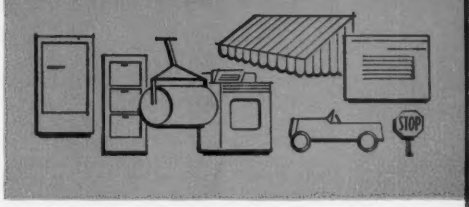
for versatile low-cost fabrication...

Satincoat is a new, zinc-coated steel that provides every advantage of imported electro-galvanized steel but at far less cost! Manufactured in Canada by the continuous galvanizing process, *satincoat's* protective zinc coat remains uniform during fabrication. Will not crack or peel to expose base metal. Takes paints, lacquers or enamels without costly priming or risk of underfilm corrosion.

For more information on the cost-cutting properties of *satincoat* . . . and the contribution it can make to the good name of your products . . . *see your steel distributor*, or write to

DOMINION FOUNDRIES AND STEEL, LIMITED
HAMILTON ONTARIO CANADA

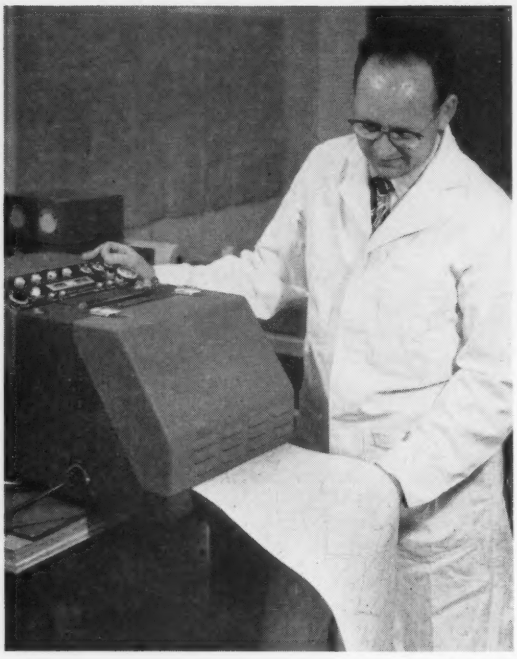
For better products at lower cost...



satincoat by Dofasco

23-5251

Oscillographs: a direct writing magazine



A direct-writing magazine that attaches to standard oscillographs (to provide developed and dried photographic records as fast as the instrument records data) is available from Consolidated Electrodynamics.

Called the 5-036 Detarite Magazine, it represents the first "systems" approach to oscillographic instrumentation. Using an exclusive high-speed system of "flash-processing," the 5-036 chemically develops an oscillogram at rates up to 25 in. per sec. The new unit features continuous (and practically instant) access to the record and furnishes a completely dried oscillogram which can be examined in full daylight while the test may still be going on.

The 5-036 is designed for direct attachment to Consolidated's widely used Type 5-119 recording oscillograph. The new unit, which is completely interchangeable with its standard magazine without modification, can be installed in a few seconds.

Imparting new versatility to the use of conventional silver-halide emulsion recording papers, the Datarite allows the use of a wide range of materials and yields excellent record contrast. When a nominal capacity of 400 ft of 12 in. paper, the 5-036 provides high information capacity for long recording runs. Datarite effectively places a new tool in the hands of engineers by eliminating the principal drawback of time-delay required for latensification or for wet-processing of the record in a special darkroom or tank. (212)

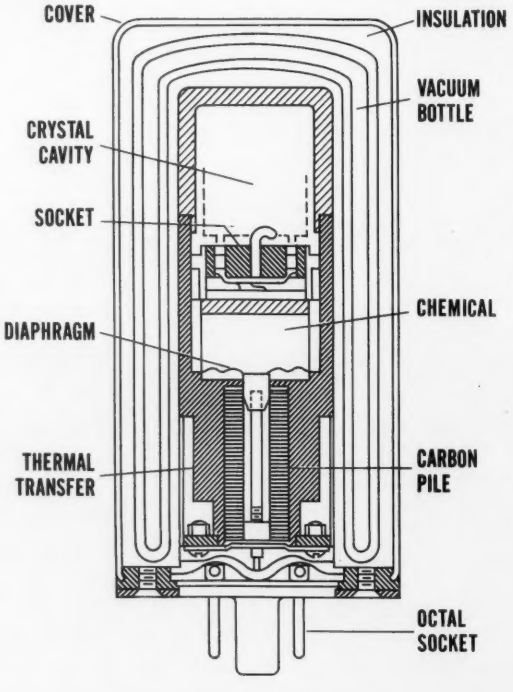
Crystal oven: it uses a chemical thermostat

A crystal oven that uses the latent heat of fusion of crystalline materials will provide extremely constant crystal cavity temperatures, according to its manufacturer.

Developed by the Aeronautical Division of Robertshaw-Fulton Controls Company, the oven uses a chemical thermostat, with a proportional heat control in lieu of the conventional bimetallic type. Contact noise, power surges, random variations of oven temperatures and cavity temperature drift are said to be eliminated.

At 24 C ambient, the cavity temperature is 70.6 C. Temperature control is within 0.5C from —20C to +50 C ambient and approximately ±0.005 C at fixed ambient.

Among the commercial applications claimed suitable for the 12 oz, 2 in. x 4 in. oven are the temperature control of a crystal or crystal oscillator for secondary frequency standards and constant temperature maintenance for thermocouple reference junctions. Temperature control of sensitive components such as resistance-capacitance networks in oscillator or computer circuits, control of zener diodes for voltage reference units in d-c power supplies and reference temperatures for the calibration of thermistors by use of ovens with varying cavity temperatures, are also possible. (213)

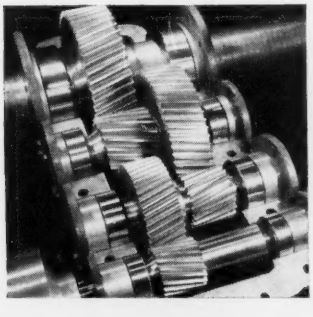


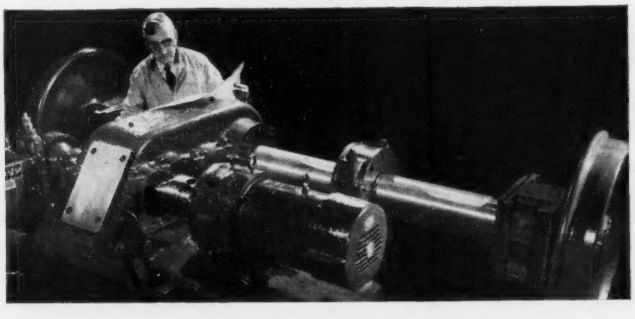
Special Self-Propelled Drive Mechanism Illustrates Engineering Skill of Hamilton Gear

When Dominion Foundries and Steel, Limited required a new type of drive mechanism for a number of self-propelled ingot mould transfer cars, they called in Hamilton Gear. The challenging problem: to move a 300 ton gross weight at a track speed of less than one mile an hour using as a source of power a 10 H.P. standard speed electric motor. The total gear ratio between the motor and the car axle is 186 to 1.

Hamilton Gear designed and built the compact assembly shown below, which incorporates an axle of the transfer car and constitutes a completely self-contained drive mechanism. It combines a standard Hamilton Gear motorized speed reducer with a specially engineered helical gear reduction box, interior of which is shown on the lower left.

For this type of unusual and complex custom design work, or for the simplest gear application in any industry, consult with Hamilton Gear. They will gladly work with you on your gear and speed reducer problems.





Hamilton Gear and Machine Co., Limited.

950•990 DUPONT ST., TORONTO 4

MONTREAL office—6785 Upper Lachine Road
WINNIPEG office—The Cuthbert Company Ltd., 19 MacPhillips St.
EDMONTON office—John H. Ross and Co. Ltd., 6803 - 104th St.
VANCOUVER office—B.C. Conveying Machinery Ltd., 3300 Fraser St.

G-1-57

Cutting tools: a 500% gain for tungsten carbide

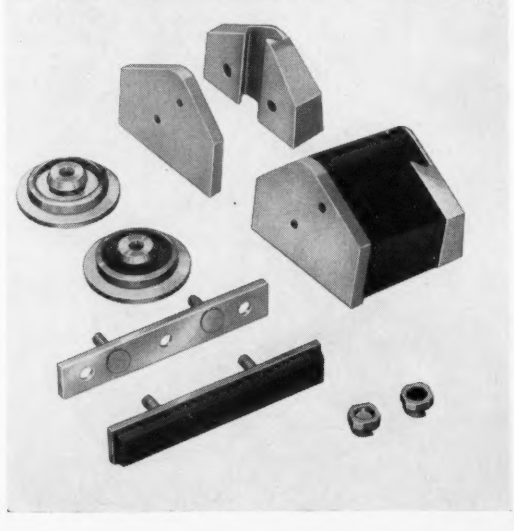
The use of solid tungsten carbide rotary cutting tools has increased more than 500% in the past 3 years, according to a recent survey conducted by the Carmet Division of Allegheny Ludlum Steel Corporation. The report states that the development of the solid carbide rotary tools has not reached its full potential, and is expected to grow rapidly in the next decade. The present gain has been brought about primarily through new applications and new designs in the tools themselves.

Many rotary cutting tools (reamers and twist drills), that were formerly tipped with carbide are now being made of solid carbide. Tool manufacturers have discovered that for many applications the solid carbide gives better over-all performance at lower cost, taking into consideration the higher initial cost of the solid carbide. Because of this, many tool fabricators are redesigning so as to use solid carbide.

The segment of the market in which Carmet is especially interested is the preforming of the solid carbide cutting tools. In preforming, the almost finished tool design is machined into the carbide while it is still in the pre-sintered or soft state, after which it is sintered or hardened in special furnaces to the hardest material produced by man. The accuracy to which the company preforms tool blanks saves the tool fabricator many dollars in time and material.

In most cases the tool fabricator need only put the finishing touches on the preformed tool bank. (214)

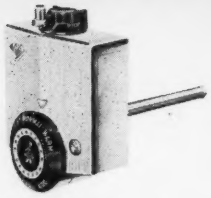
Rubber and metal bonds: parts in a thousand varieties and qualities



The rubber-to-metal bonded parts shown here are typical of the great variety and quality of solid and sponge, natural and synthetic rubber bonded assemblies manufactured by the Mechanical Rubber Products Company. Inserts (both ferrous and non-ferrous) are properly prepared and sandblasted before molding. All work is handled by a carefully trained group.

Long experienced in molding and fabricating rubber parts of all kinds, MRP have their own tool shop for mold making right on the premises, an approved test laboratory and resident government inspectors. They are familiar with government, ASTM, SAE and commercial specifications, are accustomed to handling customers' special specifications or working from their blueprints. They are equipped to handle long, short or experimental runs and offer design assistance. (215)

Everything's under control when it's controlled by Robertshaw!

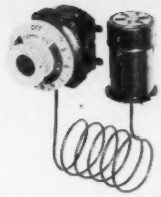


GAS WATER HEATER CONTROLS

Three new models to choose from. Many in use today. Dust proof — filter — air gap — aluminum alloy body resists gas corrosion — immersion parts of red brass and copper.

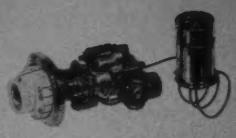
UNIVERSAL PILOT AND AUTOMATIC PILOT

New, more economical pilot — less parts — uses less gas — less failures due to linting. For use up to 200 BTU's. Automatic Pilots available in 4 directions of flow and 4 different applications.



"THERMAL EYE" ELECTRIC

Similar to gas "THERMAL EYE" but built for use on electric top surface range elements. Automatically controls the temperature of foods cooking in pans on top of the range.

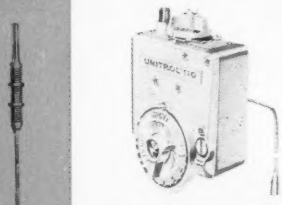


"THERMAL EYE" GAS

A new development by Robertshaw, controls temperature of foods in pans on top surface burners. Every utensil becomes a thermostatically controlled appliance.

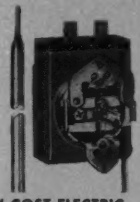
SUPER CLAD THERMOCOUPLE

Generators greater voltage output. Interchangeable with all standard pilots. Costs no more. Less trouble from outages.



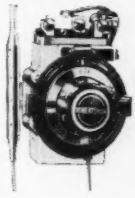
SPACE HEATER CONTROL

Unitrol 110S is a new model for automatic temperature regulation of homes heated by gas fired floor furnaces, single and double wall heaters and console heaters. No electrical wiring needed.



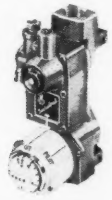
LOW COST ELECTRIC APPLIANCE CONTROLS

The EA series are precision controls with rapid response to close temperature differentials. Snap action, single pole, single line, double break. Supplied with bulbs suitable for operation in liquid or air. Small in size.



COMMERCIAL ELECTRIC CONTROLS

Ruggedly built electrical thermostats for use in industry. A great many models to choose from to suit most conditions.

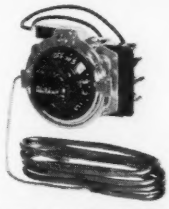


INCINATROL

A new control just released for use on gas fired automatic incinerators. A combination gas cock, automatic pilot and 4-hour timer. 100% automatic shut-off in case of pilot outage.

COMMERCIAL GAS CONTROLS

Heavy duty automatic thermostatic controls for use in industry. A number of models to choose from — snap acting, throttling type, large capacity, extra heavy duty, high temperature, etc.

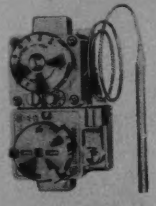


ELECTRIC OVEN CONTROLS

For use on domestic electric range ovens, with single, double or triple elements, or high speed preheat. There is a model to suit any range. Standard equipment on most ranges in America today.

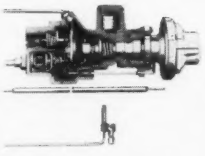
ROOM THERMOSTAT

Designed for use with all types of heating and air conditioning, radiant panels, wall and unit heaters, portable baseboard electric units, etc.



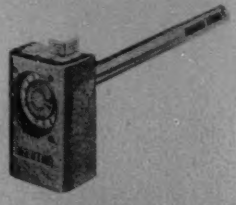
SPACE AND CENTRAL GAS HEATING CONTROL

A new control just released. Versatile — it can be adapted to suit many types of installation without special tools. Five controls in one.



GAS OVEN CONTROLS

The world famous BJ series of gas oven controls now in use on over 20 billion ranges. They feature "One dial" operation, combination gas cock and oven thermostat, 100% automatic shut-off valve. For use with all types of gases.



FAN and LIMIT ELECTRONIC CONTROLS

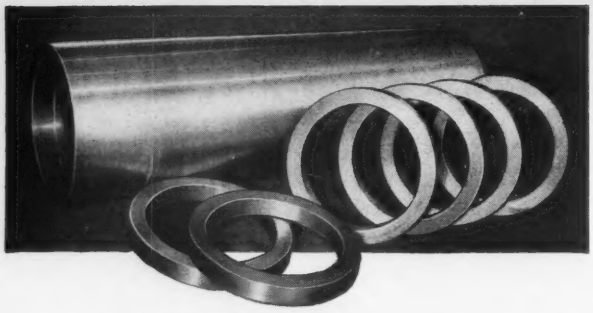
Three models. Fan control — Limit control — and combination of both. For all voltages including millivolt. Also other types of warm air heating controls.

These are just a few — for answers to any of your control problems (no obligation) write to:—

Robertshaw-Fulton

CONTROLS (CANADA) LIMITED

580 EVANS AVENUE
TORONTO 14, ONT.



Centricast

. . . alloy steel, bronze
and alloy iron tubular castings

Notable Improvement in Machine Design

How to improve the strength or wearing quality of certain machine parts without materially increasing costs has been a problem for many design engineers. Centrifugal casting by Kennedy is helping to solve the problem. Kennedy centricast metals are extremely dense, with excellent physical properties.

Cylinders of various diameters, lengths and wall thicknesses . . . supplied rough machined on inside and outside diameters, as semi-finished blanks, or as assembly parts fully machined to specifications, such as cylinder liners, ring gears, cages for roller or ball bearings, straight or flanged bushings and other parts.

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A DIVISION OF MILLSPAUGH LIMITED, SHEFFIELD, ENGLAND

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MAVITTA DRAFTING MACHINES

- A complete range of Drafting Machines for Boards up to 50 feet long, both vertical and horizontal.
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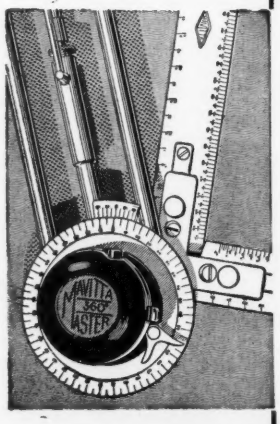
THE NEW MAVITTA 3D DRAFTING MACHINE

The new MAVITTA 3D Drafting Machine has been enthusiastically welcomed by the Aircraft, Automobile, Engineering Industries and by Architects and Building Contractors. Any Draughtsman can produce 3 dimensional drawings to scale with this exceptionally mobile unit. Clamps to any drawing board or table. Competitive prices. Enquiries invited.

THE MASTER —

latest in our range—Linkage by steel bands and pulleys—360 degrees rotation of index head — automatic location of main angles by press button through knob—quick release of head for lining up to drawings—counter balanced for vertical use — modern styling and high quality finish.



ASK FOR COMPLETE CATALOGUE DE. 58

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Agents in Canada: BRITISH BLUEPRINT CO. LTD., 1831 ST. CATHERINE ST. W., MONTREAL

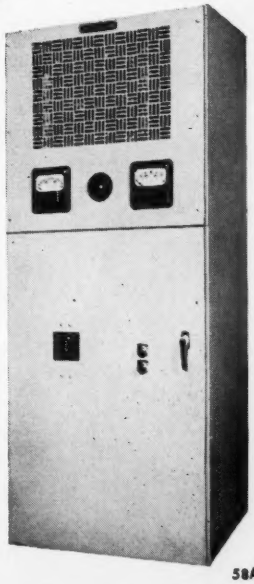
NO MAINTENANCE NEEDED!

THE NEW WESTINGHOUSE SILICON RECTIFIER

converts power in a fixed voltage AC system—and it never needs maintenance! It's an entirely new kind of DC-power source that means big savings for *you* in time and money.

How does the Westinghouse Silicon Rectifier compare with an equivalent motor-generator set?

- It's so small and light, you can mount it on a shelf or mezzanine floor where you wouldn't dare put a motor generator set.
- It costs less to install, and occupies about ⅓ of the space.
- It's much quieter in operation, and you don't have to bolt it down.
- It's more efficient—and, of course, maintenance costs are 100% less.



58A200

The new Westinghouse Silicon Rectifier is gaining great favour in modern industry as the ideal DC-power source for many types of heavy machinery. Already two of Canada's largest steel companies have ordered Westinghouse Silicon Rectifier installations.

Here is the answer to *your* DC-power needs! Call your nearest Canadian Westinghouse representative *now* for detailed information. Canadian Westinghouse Company Limited, Hamilton, Canada.

YOU CAN BE SURE.. IF IT'S

Westinghouse

Enjoy the New Dramatic Series, Westinghouse "Studio One in Hollywood" on Monday Nights TV

Control system monitors growth of a crystal

At the Lansdale Tube Co. Division of Philco Corp., the difficult problem of accurate temperature control in growing transistor crystals has been reduced to a routine production technique. The operator continuously draws a large single crystal of silicon or germanium from a crucible, induction heated to the range of 1400 C for silicon, 950 C for germanium. After manual setting of the optimum crystallization temperature, the control system maintains this set point within 0.25 C for about an hour.

Such extremely accurate control (seldom called for in industrial process applications) is obtained with a package system, specifically designed by Leeds & Northrup Co. for growing crystals. Its importance is emphasized by the consequences of temperature drifts from the set point. If the temperature rises more than some 0.6 C above the optimum growing point, the end of the crystal melts; if the temperature drops 0.6 C below the proper value, the melt freezes.

As shown in the diagram, the control system is designed to regulate the induction heater through a magnetic amplifier and saturable core reactors.

It consists of three basic elements:-

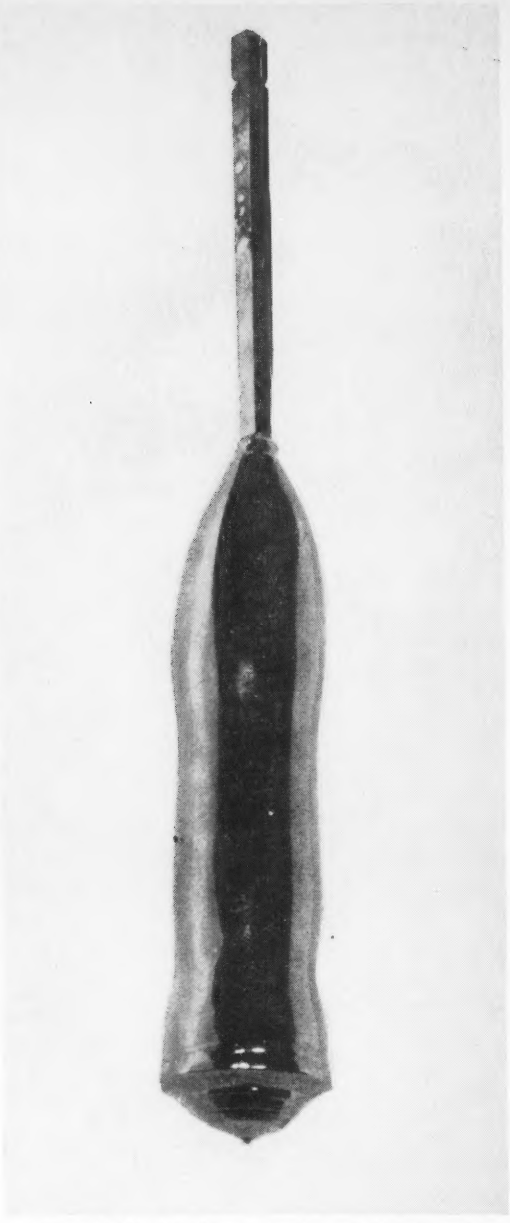
(1) a radiant heat detector (Rayotube), sighting on the bottom of the crucible.

(2) a Speedomax recorder-controller with adjustable range and adjustable zero (AZAR).

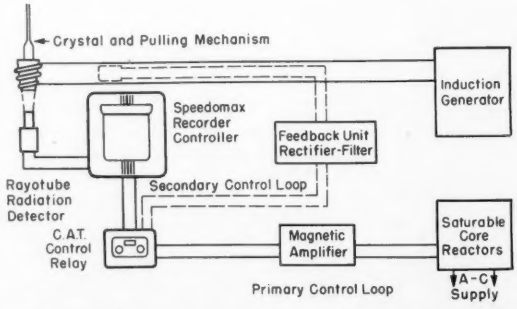
(3) a control relay (the C.A.T. or current adjusting type) which delivers a 0 to 5 ma dc signal to the magnetic amplifier in accordance with the controller's error signal.

However, even minor fluctuations in line voltage (or other effects in the circuit) could upset the delicate temperature balance. A secondary control loop has therefore been added, to compensate for these effects. In this circuit, a pick-up loop (mounted near the induction coils) keeps a continuous check on the energy level delivered to the melt. Extraneous changes in this energy level promptly cause a feedback signal to the C.A.T. unit and cause immediate corrective control action before they seriously affect the melt temperature.

Shown is a typical crystal, some 8 in. long. It is extremely pure and is cut to form the Philco transistors used extensively in electronic equipment, such as computers, radios, data processing machines, industrial controls, military communication equipment, power converters and test equipment. The company has grown crystals up to 18 in. long with the equipment described.



A crystal, 8-in. in length, to be cut for transistors.



The control system to regulate the induction heater.

Book Department

Why do materials behave as they do? **The Science of Engineering Materials** edited by J. E. Goldman (Wiley) attempts to answer this question by applying basic principles of solid state physics to the explanation of the properties of materials. Early chapters provide the necessary background in modern physics and also offer an analysis of the general scope and terminology of the solid state. These sections provide an appreciation of the basic atomistic phenomena, an appreciation which permits the use of present-day materials and allows the reader to anticipate in proper perspective the materials of the future.

The book is the work of a number of the outstanding scientists in a variety of physical and engineering fields. In defining the actual molecular makeup of materials, they explain and interpret (qualitatively) the properties of metals, alloys, semi-conductors, cements, polymers and glass.

The cost of the book is $12.00.

The first of a series of ten contemplated educational booklets on **"Systems Engineering Applied To Combustion Control"** is now ready for distribution free-of-charge by the publisher, Cleveland Fuel Equipment Co., producers of Cleveland controls.

The systems concept, which produces automation-in-combustion, is introduced in both theory and application. The need for specific instruments for efficiency and safety, and their correct integration into the system is discussed.

Thoroughly developed are the fundamentals of draft control. The requirements and mechanics are treated in an easy-to-read, step-by-step exposition. Interlocked controls and safety devices are explained.

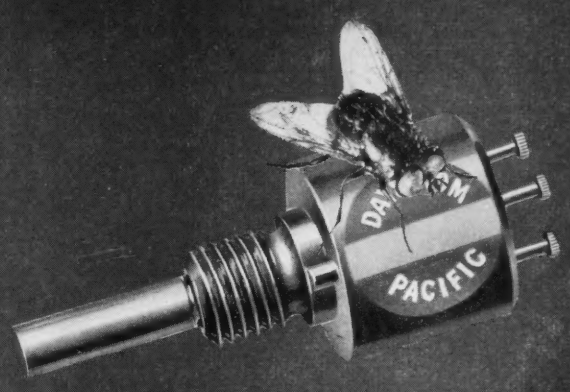
Illustrated with diagrams and pictures, the booklet is a complete, ready reference for engineers, designers and operating personnel in the combustion field.

The theory and most advanced application of differential transformers is completely treated in **"Handbook of Linear Transducers"** published by Automatic Timing & Controls, Inc. Characteristics of various differential transformers are described, tabulated and charted. Basic circuits are shown and described. Fifteen typical applications are covered.

The book provides data necessary for design engineers who wish to apply linear magnetic transducers in replacing precision potentiometers and syncros as well as develop new low impedance automatic circuitry of high precision.

looking for a **pot?**

Try the "Flyweight"



YES, try the **SERIES 304!**

When your available space isn't large enough to hold an active sand flea, but you must have a single turn potentiometer of utmost reliability and linearity, try the **SERIES 304**, a "flyweight" in the ranks of Daystrom precision, wire-wound potentiometers.

Check these outstanding features:

SIZE: 0.5" dia. by 0.375"

LINEARITY: Precision winding techniques give the **SERIES 304** a linearity of from 3% to 0.3% standard, or as good as 0.18% on special order.

RELIABILITY: The exceptionally rugged construction of this potentiometer gives it a service life of not less than 500,000 cycles.

STABILITY: Only materials of low (and similar) temperature coefficients are used in order to produce great stability under all temperatures.

AVAILABLE WITH: Integral shaft lock
Servo or panel mount
Rotational stops

Write **TODAY** for complete details on this and other precision potentiometers from **DAYSTROM PACIFIC POTENTIOMETER DIVISION!**

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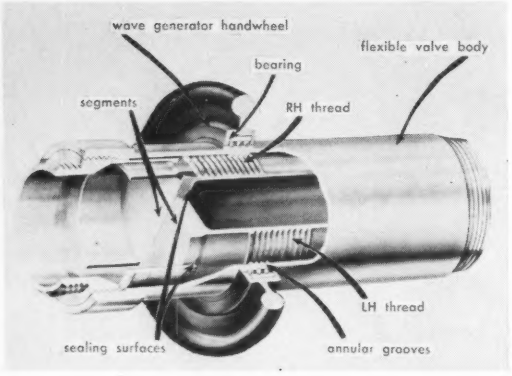
Atomic power field gets a new drive

Among the new devices displayed at the Atom Fair are examples of the "harmonic drive" principle developed by the Atomic Power Department of the United Shoe Machinery Corporation. While not yet fully proved or in commercial use, the principle offers extremely interesting possibilities, particularly in the atomic power field.

Harmonic drive makes use of controlled waves of deflection to produce powerful rotary or linear forces. Deflection waves are produced in solid steel walls of vessels, pipes or other enclosures, so as to drive mechanisms within those walls. The principle does away with the need for valve stems or other parts passing through the wall. A valve, for instance, can be truly hermetically sealed.

Harmonic Drive Valve



Description

Using the harmonic drive principle of motion transmission a hermetically sealed valve can be made with all rotating parts outside the valve. Sealed within the valve are only two moving parts (valve closure segments). Movement and control of these parts by the external motor drive is through surfaces in almost pure rolling contact.

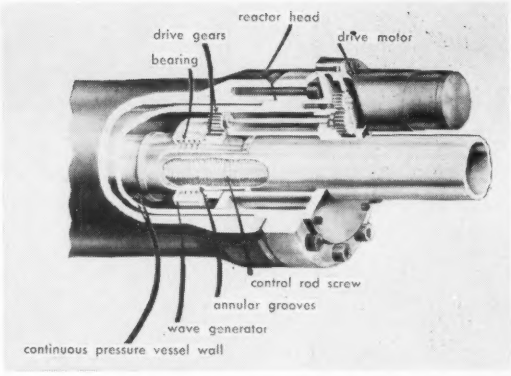
Positive position indication is accomplished by a direct, precise mechanical connection. The valve closes to a preset torque level.

Characteristics

Size (inside diameter)	6 in.
Design pressure	500 psi
Temperature (motor limitation 200 F)	450 F
Linear operating speed	25 in./min
Operating time	8 sec
Rolling contact	98%
Motor	0.2 hp
Power requirements (110 v, 60 c, single phase)	250 watts

Working parts fully enclosed
Controlled closing torque
Positive mechanical position indicator
Hermetically sealed

Harmonic Drive Control Rod



Description

With the harmonic drive principle, a hermetically sealed means of controlling nuclear reactors is available. All rotating parts are exterior to the pressure vessel. Internally, there is only one moving part. The driving surfaces are in virtual rolling contact.

Positive position indication is accomplished by a mechanical indicator that is (at all times) directly connected and responsive to the control rod position.

The mechanism can be driven by any conventional power source.

Characteristics

Normal operating pressure	2200 psi
Normal operating temperature	565 F
Hydrostatic test pressure	3750 psi
Maximum operating temperature	650 F
Linear speed of control rod	20 in./min
Length of travel	30 in.
Projected tooth contact area	2.66 sq in.
Maximum thread contact stress at 100 lb load	1195 psi
Maximum permissible load at 70° F	74400 lb
Maximum permissible load at 650° F	67200 lb
Rolling contact	97.5%
Motor	0.5 hp

Hermetically sealed
Positive mechanical position indication

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THERMOCOUPLES AIRCRAFT	Gasket, Bayonet, Rivet, Stagnation, Shielded, Exposed Loop and MIL Specification Thermocouples. Harness and Rake Assemblies. AN Firewall Quick Disconnect. AN Resistor. AN Thermocouple Extension Lead Assemblies.
THERMOCOUPLES MINIATURE	Gasket, Bayonet, Exposed Loop, Protected, "Plastic Melt" and Shielded Thermocouples. Terminals and Quick-Coupling Connectors.
THERMOCOUPLES INDUSTRIAL	Tubular, Wire-Type, Noble Metal, and Base Metal Thermocouples. Bar-Stock and Built-Up Protection Tubes. Connection Heads and Fittings. Quick-Coupling Connectors.
WIRE & "CERAMO" WIRE	Thermocouple and Thermocouple Extension Wire. MIL Specification Wire. Ceramic-Insulated and Metal Sheathed "Ceramo" Wire — OVER 1500 TYPES.
CONNECTORS PANELS SWITCHES	Quick-Coupling Connectors. Connector Panels. Key-Type, Push-Button and Rotary Selector Switches.
CONTROLLERS	Potentiometer and Resistance Bulb Signaling. Recording. Indicating. Multi-Point.
RECORDERS	Indicating. Portable Indicating.
INDICATORS	Millivoltmeter-Type. Potentiometer-Type. Self Balancing. Self Balancing with Built-In Switches. Portable Self Balancing Manual Balance. "MiniMite" Portable Potentiometer-Type.
SPECIAL INSTRUMENTS	Temperature Monitoring System. "Auto-Ref" Cold Junction Units. Calibration Consoles.

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✓ DEPENDABILITY... R&M has it
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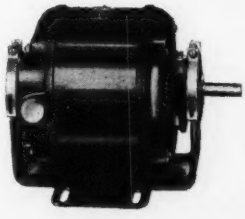
✓ LIGHTNESS ..... R&M has it
✓ PERFORMANCE... R&M has it
✓ RANGE ..... R&M has it
and MORE ..... R&M offers a motor especially designed to get top performance from your equipment. Motors of the right size, speed, frame and torque characteristics to fit your exact requirements.

The simplest, most convenient single phase motor on the market!

Low first cost, reliability of performance and simple maintenance requirements put the R & M Split Phase motor out front! Ideally suited for propeller fan, blower fan or fan belt drive applications where low starting torques may be combined with high efficiency and low starting currents.

Specify R & M motors for top quality . . . for top performance from your equipment.



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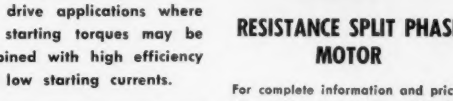

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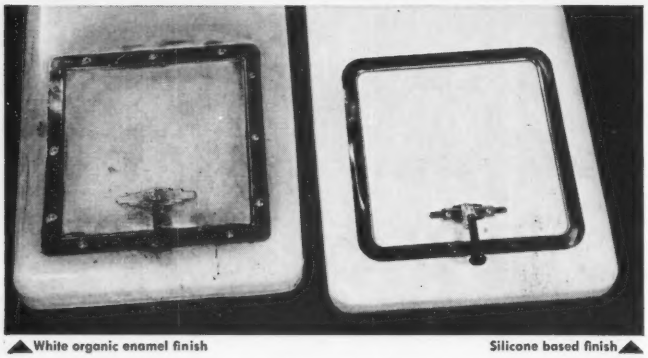

White organic enamel finish — Silicone based finish

Here's the kind of superior color and gloss retention you can expect with paints based on Dow Corning silicone resins. After a few weeks exposure to temperatures up to 500 F, the finish on the incinerator cover at left is ruined, whereas the silicone based finish on the cover at right looks like new.

Finishes based on Dow Corning silicones provide superior resistance to corrosion and weather.

Your products still look *good as new after years of service* when you specify Dow Corning silicones in the finishes you use.

Write today for a FREE personal copy of this new, fact-filled brochure which contains a list of paint manufacturers who sell silicone based paints.

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Thermostats

(Continued from page 41)

the motor from overheating.

The expanding probe type.

Although one of the most recent additions to the thermostat field (see Fig. 4 and Box) it has almost overnight become the most popular thermostat in the kitchen appliance field for the temperature control of such items as electric skillets, griddles and the like. Its popularity stems from one thing only: it is a thermostat designed to provide good variable temperature control and yet be removable from the parent appliance which can then be totally immersed in the dish water.

To achieve these features in the thermostat, the principle of differential expansion is utilized. The outer shell of the probe (which is the heat sensing element) is aluminum, which exhibits a relatively high thermal expansion rate plus excellent heat conductivity. Down the centre of the hollow aluminum probe is a nonexpanding push rod which opens and closes the electrical contacts in response to the expansion or contraction of the aluminum.

Because the control must be removable, a certain amount of clearance has to be maintained between the outer diameter of the probe and the inside diameter of its mating hole. Under these circumstances a good conductive fit is not always possible and to minimize this loss, the probe is anodized black to increase its heat pick up ability.

Should anything happen to damage the probe or push rod, the contacts will automatically spring open in a fail-safe condition.

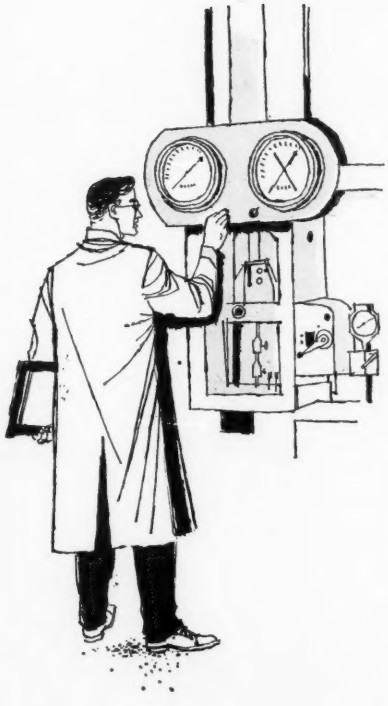
This control is also available with a stainless steel probe housing for water immersion applications and with a ½ in. pipe thread nipple for waterproof mounting in liquid tanks..

We have drawn brief pictures of some of the more widely used thermostats of today. It must be remembered that the perfect thermostat for most new applications has not yet been invented and that to make use of an available one, compromises must often be made somewhere along the design road. For this reason, absolute realism must be used in setting up thermostat requirements and the thermostat manufacturers should be called into the design picture as soon as possible.

Otherwise, the project may wind up like that of one manufacturer who designed and tooled a complete product and then realized he needed a thermostat. Before he succeeded in obtaining the performance he desired he had to retool five pieces, including a casting. That was the cheapest way out. ★

When the demand is for QUALITY...

SHAWINIGAN STAINLESS STEEL



Why does industry demand 'Shawinigan' Stainless Steel when it wants castings of the highest quality?

Because experience has convinced our customers that Shawinigan's *full laboratory control* of every processing stage produces the finest corrosion and heat resisting castings in Canada.

Every casting produced by Shawinigan is closely checked and inspected at every stage of the process. X-ray tests, Gamma radiography, fluoroscopic examination of non-magnetic materials and magnaflux inspection of ferritic and martensitic type stainless steel . . . these are only some of the checks employed by Shawinigan.

Discover how you can be sure of top quality and save money by using 'Shawinigan' Stainless Steel corrosion and heat resisting castings.

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Protective coatings

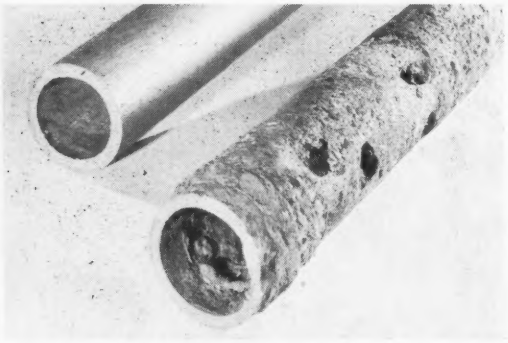
Nickel protection for ferrous metals

A process that prevents scaling of the base metal up 1150 deg. F.

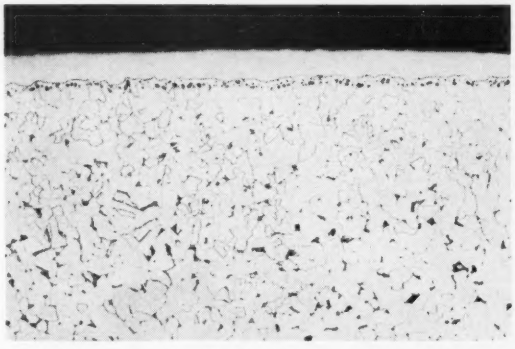
A method of applying nickel-alloy coatings known as the Niphos process (Tube Reducing Corporation) is now available for industrial applications calling for corrosion (or wear) resistance when using ferrous metals. Easily applied to all shapes and sizes, the coating is heated in a reducing atmosphere to provide a tightly adhering nickel-alloy cladding that will not peel or flake even when subjected to a 180 deg bend.

What is more, the clad coating can be applied locally to areas which are to be joined by brazing, after which the brazing operation is carried out merely by placing the coated areas in contact and heating them. Average coatings, applied primarily for corrosion protection, are about 0.001 in. thick, but coatings up to 0.025 in. thick can be obtained in one application. This thickness can be increased still further by repeated applications, so that it is possible to resurface or build-up worn base metal areas.

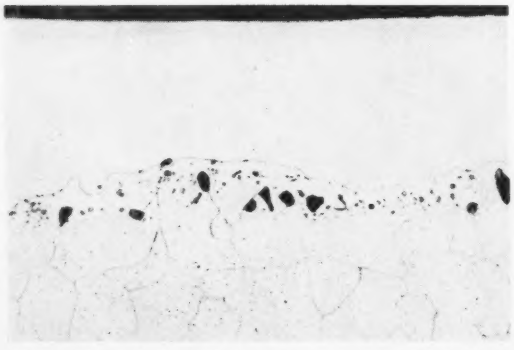
The coating can prevent scaling of the base metal at temperatures as high as 1,150 F. Niphos-coated areas, when properly welded, suffer no loss of corrosion protection in the weld-affected area. ★



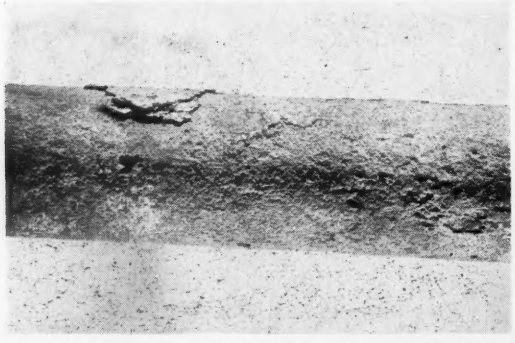
Two identical pipes, one Niphos-clad and the other untreated, after the same length of time in service.



100X photomicrograph shows homogenized grain structure on pipe and Niphos coating from .002 to .0025 in.



500X photomicrograph (same area as top right) shows dark islands, probably iron, nickel and phosphorus.



Detail of the normal corrosive action after a year of service in heating coil system of an oil tanker.

what's special about a Canada Iron DOMITE* casting?

What will it do for you? Will it save money? Will it reliably meet specifications? Will it possess longer life? The answer is "yes" to all three. Because Domite is superior cast iron. Domite is laboratory controlled to meet the need with the properties you require.

Canada Iron is Canada's oldest foundry organization. They have the experience, the laboratories and the metallurgists. Get the most for your casting dollar . . . Call Canada Iron, their representative will give you full details.

Canada Iron manufactures all grades and types of cast iron, for convenience classified as follows and complying fully with A.S.T.M. A48 where applicable. Here are some typical examples:

DOMITE "30":
Better than average cast iron.
Minimum tensile strength 30,000 psi.
Typical Brinell hardness 200.

DOMITE "40":
High strength, medium cross-section.
Minimum tensile strength 40,000 psi.
Typical Brinell hardness 235.

DOMITE "50":
High strength, heavy cross-section.
Minimum tensile strength 50,000 psi.
Typical Brinell hardness 260.

DOMITE WEAR RESISTING:
Type WR—A, B, C and D
(type depending on service involved).

DOMITE HEAT RESISTING:
Type HR—A, B, C and S
(type depending on service involved).

NI-HARD:
Alloyed white iron, Brinell 600-725.

NI-RESIST:
High nickel alloy cast irons for corrosion and heat resistance. Tensile strength 25,000 to 30,000 psi, Brinell 130-180.

DUCTILE NI-RESIST:
Composition and properties as for Ni-Resist, but with 60,000 psi tensile strength and 10% elongation, strong and shock resistant.

NODULOY, DUCTILE IRON:
Nodular or ductile cast iron in a complete range of properties, from 60,000 psi tensile and 20% elongation at 160 Brinell to 180,000 psi tensile at 330 Brinell. Available also in special heat resistant grades.

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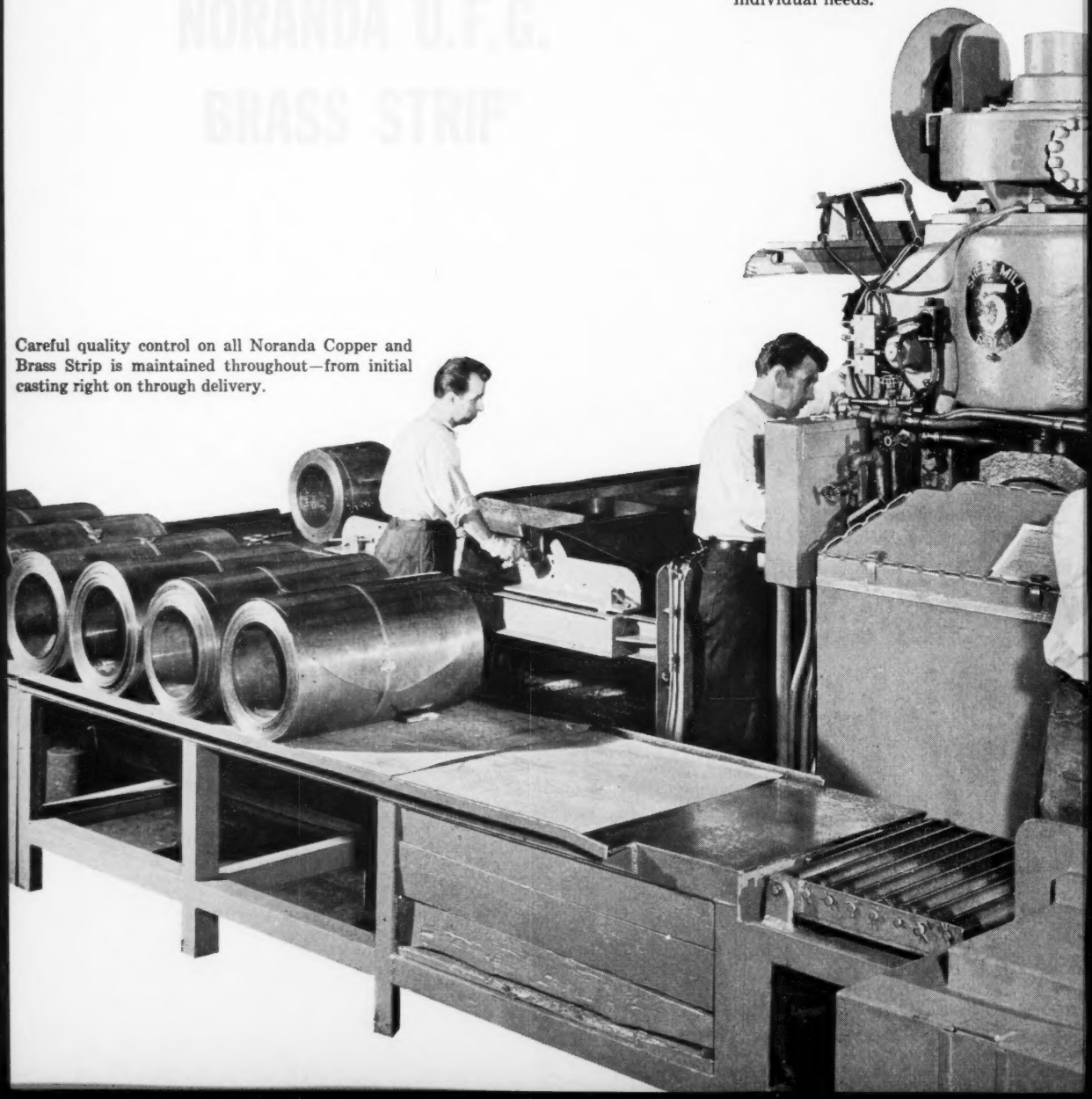
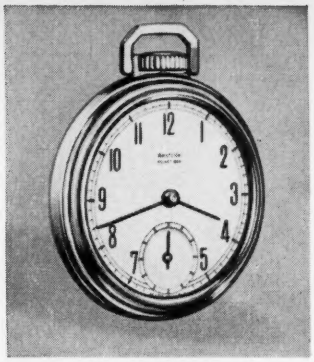
Noranda *Ultra-Fine-Grain Brass Strip offers these three features—an absolute minimum of polishing, ability to take a fine plated finish and most important, low price—a combination of advantages that adds up to better quality at lower cost.

Noranda Ultra-Fine-Grain Strip is fabricated to meet your forming needs *exactly*. It is readily formed, stamped and shallow-pressed; and its fine grain structure presents a surface so smooth and even that most finishes require only a color buff.

To get the complete story, SEE THE MAN FROM NORANDA. Our Technical Service Representatives will be pleased to assist you in the selection of correct grain size and temper to suit your individual needs.



Careful quality control on all Noranda Copper and Brass Strip is maintained throughout—from initial casting right on through delivery.



Plated U.F.G. beauty is apparent in these fine products. Case of the Westclox Pocket Ben by Western Clock Company, Ltd., and fishing lures by Lucky Strike Bait Works Ltd. are outstanding examples of low-cost fine finishes obtained with U.F.G. Brass Strip.

Noranda makes an extensive range of copper and brass strip and sheet to meet a wide variety of drawing, spinning, stamping and engineering applications. Because so many different characteristics can be "built into" copper alloys you can meet almost any product or production requirement with ease. Regardless of the material you are now using, it will pay you to discuss your strip and sheet needs with the Man From Noranda... chances are he can show you new ways to use copper alloys to better advantage.

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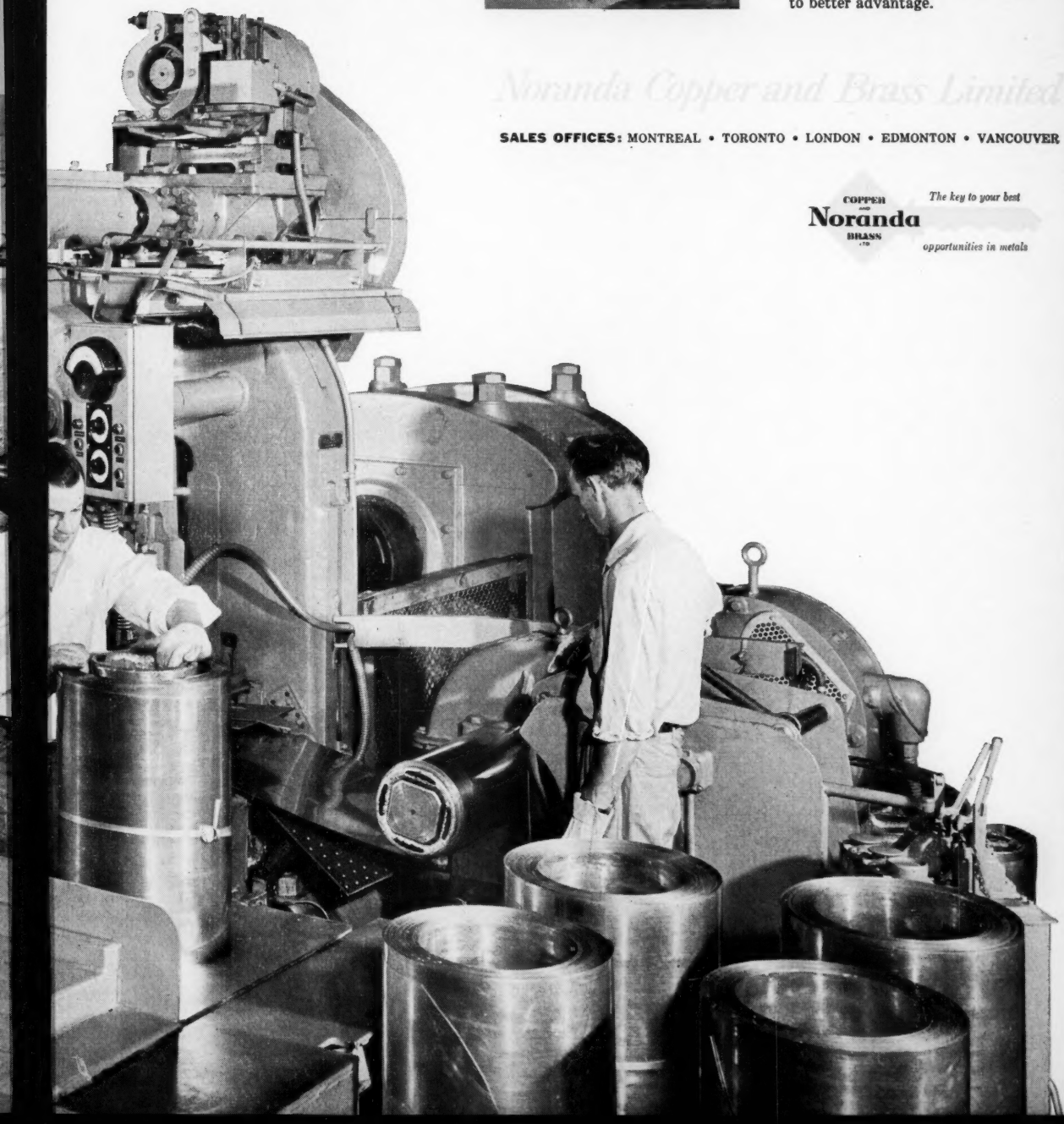

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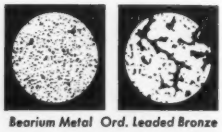
Words cannot describe the advantages and the superiority which BEARIUM METAL offers over all other types of bearing materials. Only when you use it under the most difficult operating conditions can you appreciate its amazing superiority.

So, if you have a bearing application which involves high speeds, poor lubrication, excessive loads, elevated temperatures, dusty and gritty surroundings—or where a liquid other than oil must be used as a lubricant ... BEARIUM METAL will prove to be your best investment.

THE SECRET OF BEARIUM METAL'S superiority is due to the uniform distribution of microscopic lead particles within the copper-tin grains rather than between the grain boundaries—as illustrated by these two photomicrographs.



Bearium Metal Ord. Leaded Bronze

FEATURES: Non-Seizing and Non-Scoring • Long-Wearing • Self-Lubricating • Low Coefficient of Friction • High Compressive Strength • Resistant to Shock Loads • Sound, uniform structure • Free Cutting.

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New products & materials

Firing temperature control

Complete information about **Leeds and Northrup's** equipment for firing temperature measurement and control for rotary kilns appears in a four-page data sheet just published. It explains the advantages of the rotary kiln firing temperature measurement and describes how equipment is applied for reliable measurements.

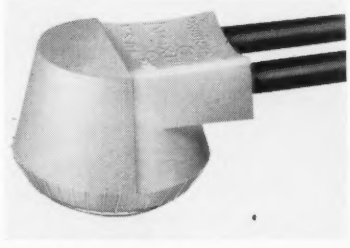
Included in this data sheet are photographs and diagrams illustrating details of the system and its installation. (216)

Vacuum gauge

An inexpensive, single-station, panel-mounted thermocouple vacuum gauge is now available from the Rochester division of **Consolidated Electrodynamics Corporation.** Designated the TG-025, the gauge operates on two size D flashlight batteries contained within its housing. Two terminals are provided on the bottom of the instrument for connection to an external battery power supply.

The range of TG-025 (from 0 to 1000 microns Hg of dry air pressure) is covered on one non-linear scale, with 5 microns the smallest indicated marking. The pressure range from 0 to 60 microns Hg extends over more than half the entire scale.

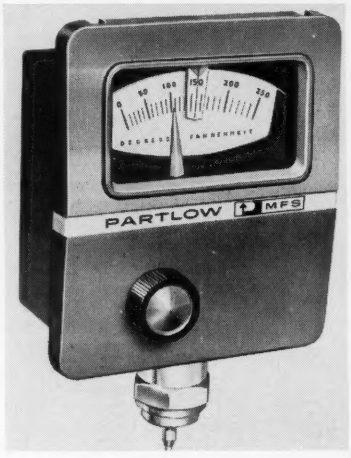
The TG-025 is equipped with an all-metal sensing tube (Type TG-77) and is not harmed by exposure to atmospheric pressure. (217)



Sealed thermostat

Added recently to the Klixon temperature control line (**Metals and Controls Corporation**) is the low-cost Type 20220 thermostat, designed to seal out moisture and dust in refrigeration and air conditioning applications. The control is a disc type, single-pole, single-throw thermostat with automatic reset at fixed temperature settings. Various differentials and tolerances are offered within the temperature range of —20 F to + 167 F.

The thermostat is rated at 25 amps, non-inductive, 120/240 VAC for 100,000 cycles. The unit is completely enclosed in a neoprene boot, except at the bottom of the thermostat, where the actuating element is located. It is sealed at both the lead and cup openings by an epoxy resin compound. (218)



Temperature control

A mercury-actuated indicating temperature control, redesigned by Raymond Loewy Associates, features a novel dual-mounting design and greatly improved readabiltiy. The instrument (Model MFS) has just ben introduced by **The Partlow Corporation.**

Said to be accurate to within ½% of scale range, the controller will sense, indicate and control processes and appliances within the range of —30 F to 1100 F. It is available in 10 different scale ranges. Its wide range of application includes all types of process operations, industrial ovens, furnaces, kilns, dryers and packaging lines were temperature tolerances are close.

Designed into the instrument is a readability feature, called "Accu-Vision," which aims at for accuracy in setting and reading the instrument, and for eliminating the possibility of error. This feature includes an increased dial area; a special magnifying setting-pointer equipped with two hairlines for parallax sighting, plus an optically-designed combination of dial colors for the greatest possible contrast.

The instrument design also features a mounting arrangement that permits the case to be flush or wall-mounted without any additional mounting brackets or hardware. The contours of the case also allow the mounting to be done completely from the front of the panel. (219)

Continued on page 80

DU PONT CANADA

PRODUCT ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

Cost of Hose-Couplings Reduced when Moulded of Corrosion-Resistant Zytel Nylon

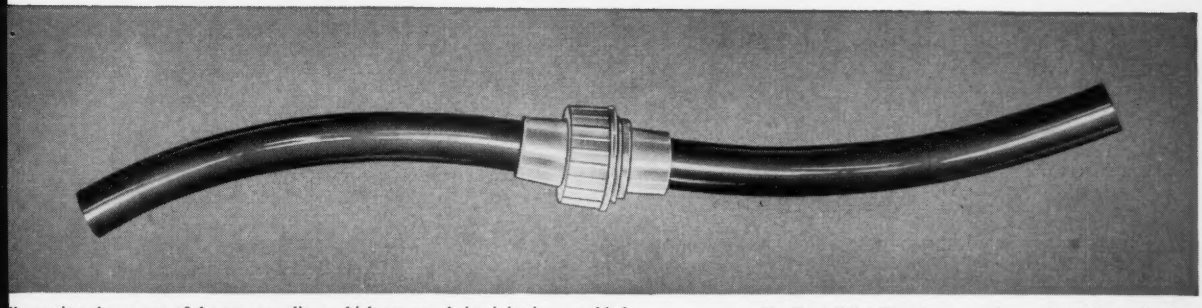


Illustration shows one of the new couplings which are now being injection moulded for use with standard ½ inch rubber or plastic hoses. These couplings are designed for high strength, ease of attaching and removing, low pressure loss and low cost.

Du Pont "Zytel" nylon was chosen for this application because of its high corrosion-resistance and overall durability.

The high strength and durability of "Zytel" nylon is put to a good use in this coupling for garden hose, now available both to manufacturers and retail outlets through Star Plastics Company, 194 Marion Street, Toronto. Thoroughly tested and completely reusable, the new coupling is said to cost less than any other coupling of comparable design now on the market. The high sales appeal resulting from the long standing association of nylon with top quality in plastics applications should make this item an immediate favourite.

Both its low cost and outstanding durability result from the combination of "Zytel" nylon resin with a good design. "Zytel" nylon is an engineering material, having overall strength not approached by any other common plastics material. Other outstanding properties frequently used in many "Zytel" applications are abrasion resistance, low coefficient of friction and high heat resistance. Imaginative designers are constantly uncovering new applications to utilize these properties. To meet the resulting demand, "Zytel" is now being manufactured at Du Pont of Canada's Kingston Works.

The availability of good materials, however, does not mean much without experienced, conscientious firms capable of converting them into useful products. This hose coupling is one of several dozen "Zytel" nylon articles moulded by Toronto Plastics, 15 Mobile Drive, O'Connor Post Office, Toronto, whose outstanding success in tooling and moulding of nylon parts marks them as one of North America's leading moulders of mechanical parts.

DU PONT COMPANY OF CANADA (1956) LIMITED,
CHEMICALS DEPARTMENT, P.O. Box 660, Room A-4, MONTREAL, QUE. DE-2

Please send me more information on the Du Pont plastic engineering materials checked: ☐ *"Zytel";* ☐ *"Alathon";* ☐ *"Teflon";* ☐ *"Lucite". I am interested in evaluating these materials for*

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TYPE OF BUSINESS_____

*"Alathon" "Lucite" "Teflon" and "Zytel" are registered trade-marks of E. I. du Pont de Nemours & Co. (Inc.)

Are you looking for better performance at lower cost? Du Pont field service representatives will help you decide at no cost and with no obligation, if the use of "Zytel" nylon, or one of the other Du Pont engineering materials can achieve this for you. Fill in the attached coupon, or write us.

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ANALOG COMPUTER—Your design and application problems can be solved more economically in less time at the Westinghouse Computation Centre.

ENVIRONMENTAL AND APPRAISAL LABORATORY—The most complete in Canada. Your products and components can be operated and tested under all environmental conditions and to most military specifications.

ANTENNA RANGE—Especially designed, this Antenna Range has automatic recorders to give antenna design and production testing information in the shortest possible time.

These Westinghouse facilities are a valuable aid in obtaining rapid solutions to your design, production and application problems. They are available to you on a *rental fee basis*.

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Canadian Westinghouse has prepared a special booklet detailing the equipment and the performance of these various facilities. Write to Electronics Division, Canadian Westinghouse Company Limited, Hamilton, Canada, for a free copy of this new booklet.

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57H745

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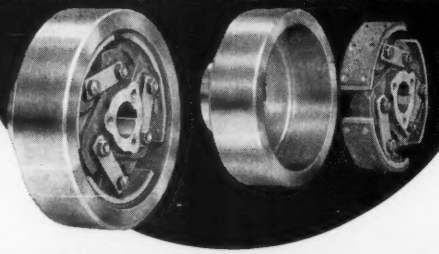
Flexible ACTION IN THE *New* HILLIARD TWIFLEX

AUTOMATIC CENTRIFUGAL CLUTCH COUPLING



11 NEW IMPORTANT FEATURES . .

1. Flexible in all directions.
2. Absorbs Shock.
3. Limits torsional vibration.
4. Has adjustable idle speed
5. Can be furnished in automatic free-wheeling type.
6. Smooth starting.
7. No slip under normal load at full speed.
8. Protects driver and driven mechanisms against overload shock.
9. Can be furnished in automatic backstop type.
10. Prevents torsional resonance.
11. Easily assembled even in blind installations.

If you have problems of misalignment - smooth starting - vibration - overload - or assembly in the manufacture or operation of:

- Compressors
- Blowers
- Diesel Engines
- Excavators
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- Hammer Mills
- Textile Machinery
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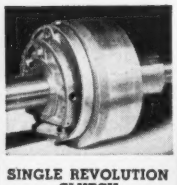
- Fans
- Gasoline Engines
- Back Stop Brakes
- Mixers
- Conveyors
- Pumps
- Electric Motors
- Generators
- High Speed Pulverizers
- Tube Mills

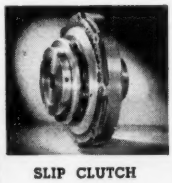
- Let Our Engineers Consider Your Problem. Twiflex May Be The Answer.



OVER-RUNNING CLUTCH

For automatic engagement and release on two speed drives, dual drives and for ratchet feed or backstop action.

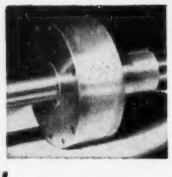
Write for Bulletin 231.



SLIP CLUTCH

For overload protection — constant torque — constant tension on reeling or winding stands.

Write for Bulletin 300.



SINGLE REVOLUTION CLUTCH

For automatic, accurate control, electrically or mechanically, of intermittent motion, indexing, cycling, cut-off.

Write for Bulletin 239.

WRITE TODAY!

For Details of TWIFLEX Coupling in Catalog CE-3

IN CANADA: UPTON BRADEEN-JAMES LTD.
890 Yonge St. - TORONTO • 3464 Park Ave. - MONTREAL

THE HILLIARD CORPORATION

30 W. FOURTH ST. — ELMIRA, N. Y.

MANUFACTURING CLUTCHES FOR 50 YEARS

Thermostats

(Continued from page 37)

stat bimetal. We have already observed that, of these factors, only the temperature differential is truly constant; the other factors are constants only within limits. Hence, when we substitute these values in the relevant formulas (for any given bimetal in any given shape) we shall produce not one set of values for force and deflection, but a series of such values, **within the limits of the variables.** Here's how that series is obtained.

Each bimetal possesses certain constant values relevant to the formulas under consideration. When they are substituted in the formulas (together with the constant temperature differential), only one set of variables—the dimensions—remain. But remember, they are "limited" variables. The designer now substitutes the values of his upper and lower dimensional limits, and as many sets of intermediate values as he feels are necessary. Each substituted set of dimensional values will produce a separate value for force and deflection. In this way, a series of force and deflection values is computed **for a given bimetal of given shape under a given condition.**

Under the same conditions of work, the calculation is repeated for each of the possible bimetals for that shape. Then the calculation is repeated for each of the possible bimetals for all the possible shapes. The result is a series of force and deflection values for each shape as a function of the bimetal and its dimensions. It is a simple matter now for the designer to match up his required force and deflection values with the values computed in this manner. The computed values most closely approaching the required values determine the selection of the shape.

In addition, since force and deflection are functions of the bimetal and its dimensions, the combination of force and deflection values that determines the shape **simultaneously determines the ultimate choice of the bimetal, and with certain exceptions the final choice of the dimensions.** Hence, by simple substitutions in a series of elementary algebraic equations, the major problems of the thermostat designer are solved. These equations are given in the Table. ★

Changing your address?

If you change your address be sure to notify our subscription department quoting both your old and new addresses.

3 JOHN CRANE "Pressed-In" SEALS

for economy, quick installation and life-long performance in all types of service

TYPE 11-A

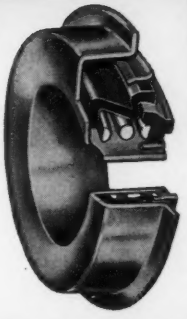
Synthetic Rubber Bellows • Small shafts to ¾ in.

Services: hot or cold water, oil, gasoline, kerosene and other liquids non-injurious to synthetic rubber.

Pressures: up to 50 psi.

Temperatures: –65°F. to +220°F. Special construction to +300°F.

Construction Data: Packaged unit. Retainer does not contact shaft, permitting operation at a high rpm. One size can be used for several shaft sizes. Bellows encloses spring and metal parts to prevent contact with medium being sealed.



TYPE 6-A

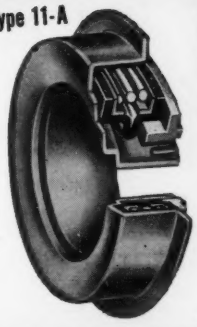
Synthetic Rubber Bellows • Interchangeable with Type 11-A

Services: hot or cold water, oil, gasoline, soapy and other liquids non-injurious to synthetic rubber.

Pressures: up to 75 psi.

Temperatures: –65°F. to +220°F. Special construction to +300°F.

Construction Data: Similar to Type 11-A. Does not contact shaft, permitting operation at high rpm. One size can be used for several shaft sizes. Spring and metal parts available in stainless steel or bronze.



TYPE 9-A

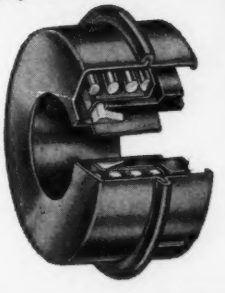
Sealing Members Made of Teflon* • Engineered for the particular application

Services: all chemicals, solvents, oils, corrosives and gases, hot or cold.

Pressures: to 150 psi. Balanced construction to 750 psi.

Temperatures: –120°F. to +500°F.

Construction Data: Packaged unit. Furnished in metallurgical specification best suited to the application. Chemically-inert Teflon wedge ring closely fits inner sleeve of retainer and is machine-mated to carbon sealing washer.



Contact "John Crane" for the particular seal best suited to your application. Request bulletin giving full information on "John Crane's" complete line of mechanical seals.

CRANE PACKING COMPANY, LTD.
631 Parkdale Avenue North, Hamilton, Ontario.

*DuPont trademark

JOHN CRANE CRANE PACKING COMPANY 38 YEARS INDUSTRIAL PROGRESS

New products
continued

Over-running clutch

Two complete lines of standard over-running Precisionspring clutches have been introduced by the Marquette Division of **Curtiss-Wright Corporation.** One line consists of ball bearing clutches ranging from 20 to 3,000 lb ft torque capacity; the other line is made with sleeve or plain bearings in 8 lb in. to 200 lb in. torque capacity.

These standard clutches are suitable for all over-running, indexing and backstopping applications.

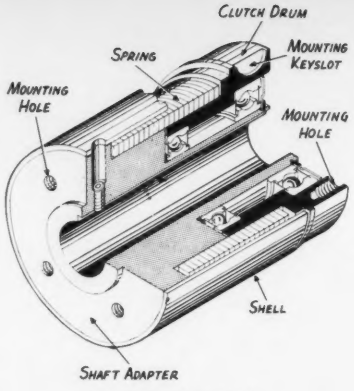
Two of their important characteristics are long life and low maintenance. When such a clutch "takes hold," there is practically no movement of the spring on the surface it is gripping. The spring and both units revolve as a solid unit, and there is practically no wear. Since the clutch is self-adjusting, the driving torque is constant throughout the life of the clutch. (220)

Clamp-type cylinder

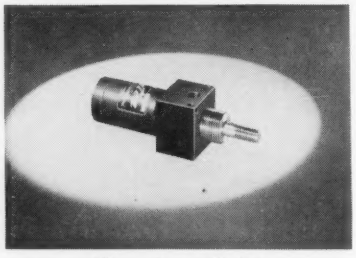
A clamp-type air or hydraulic cylinder (distributed by J. B. Morrison Machinery Co. Ltd.) is manufactured by **Carter Controls Inc.** It is applicable to many different uses in many different plants. Among the applications suggested are those connected with toggle operations, spring return motions, die set strippers, pilot operation of valves, opening of die sets, multiple holding and clamping operations, jigs and fixtures and so on.

The new cylinder is low in original cost and has design features that give it considerable durability in continuous operation. The cylinder is of all steel construction, except for bronze bearings and synthetic piston packing. The packing gives the cylinder a range of successful operation between —55 F and 250 F. The cylinder is basically built like the Carter standard line; small, compact and very convenient to install.

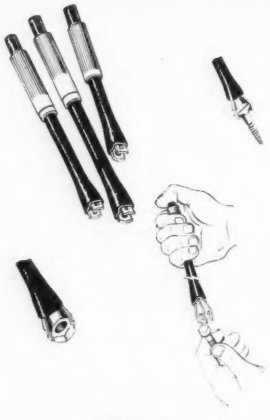
The standard unit has a universal mount allowing threaded nose, foot, front or rear flange mounting. Pivot, trunnion, clevis mountings are available on special order. Each single cylinder is individually packaged and serially numbered for stocking and recording. (221)



Over-running clutch
A long life and low maintenance.



Clamp-type cylinder
Durability in continuous operation.



Wrench
It's easy in hard-to-reach places.

Wrench

The Tip wrench, made by **Tipco Manufacturing Co.,** tightens or loosens nuts, bolts and slotted machine screws. It eliminates finger fumbling and makes it easy to get into hard-to-reach places.

By applying thumb pressure on the plunger head, the jaws open and slide out to the desired size. As pressure is released, the user is ready to go in and complete the job. Capacity ranges from No. 2 to No. 12 nuts and bolts. The tool is completely shock proof. (222)

Thermal wells

Complete specifications on wells for thermostat applications in fluids, gases or high pressure environments are included in a new catalogue prepared by **Fenwal Incorporated,** manufacturers of precision temperature controls.

The two-page catalogue describes copper and stainless steel designs suitable both for immersion and surface mounting. Each of the seven designs listed has complete dimensions, operating specifications and ordering data. (223)

Thermal element corrosion

Selection of thermal elements for maximum resistance to corrosive atmospheres is made easy with a new folder recently published by the **Partlow Corporation.** The folder (Thermal Element Selection Guide for Corrosive Atmospheres) lists more than 400 separate atmospheres into which temperature control elements are often immersed. In easy-to-read chart form are listed the recommended bulb material and information on sustaining the life of temperature sensing bulbs in any atmosphere. (224)

Continued on page 82

Grey and Alloy Iron Castings

SINGLE OR PRODUCTION RUNS

Maximum per Casting 5 Tons.

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FOLEY FOUNDRY & MACHINE CO. LTD.

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"A Fine New Foundry With Over 100 Years Experience".

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Name .....

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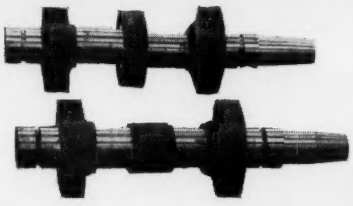
Gray iron castings

(Continued from page 32)



Crankshafts

Modification: Steel forgings to gray iron castings.

Company: Carrier Corporation, Syracuse, N. Y.

The crankshafts, which are for compressors used in air-conditioning and refrigeration applications, replace original designs using steel forgings.

Average savings on unmachined shafts: 33%
Maximum savings: 50%
Average savings on finished shafts: 17%
Maximum savings: 22%

In addition, patterns cost as much as 70% less than forging dies.

Cast shaft performance was equivalent to that of the hardened forged steel shafts formerly used.

The shafts range in weight from 5 to 432 lb and are from 11½ to 47 in. long.

The smaller shafts shown are of ductile iron, whilst the larger shafts are of pearlitic gray iron with a controlled graphitic structure. ★

No time like the present

LOTS OF YOU ENGINEERS have the nucleus of an article tucked away in a drawer somewhere, either in the form of rough notes or as a rough typescript.

The reason, of course, that you haven't done anything about it is because you probably feel that nobody will be interested in publishing it—so why do all the work necessary to get it in shape for nothing?

There is somebody interested in your technical article: DESIGN ENGINEERING is always on the lookout for suitable contributions. Not that we are short of material, mind you. But it does seem a pity that good stuff should not see the light of day.

Why not act at once and tidy up that article, get it typed and submit it to DESIGN ENGINEERING? If we like it enough to publish it, you will be paid. Not a fortune, perhaps, but enough to make it worth your while.

And think of the personal satisfaction of seeing yourself in print.

Welding technology, steadily enriched by research and invention as it continues to meet the demands of industry, has much to offer the design engineer.

Continuing research and engineering have resulted in the development of equipment, techniques, procedures and materials for faster and more economical fabrication of both ferrous and non-ferrous metals.

This is illustrated in the various automatic and semi-automatic welding processes in use in many manufacturing industries turning out products *designed for welding.*

It may be to *your* advantage to assess your design and fabrication methods with a view to incorporating some of these highly efficient and economical welding processes in your production lines. They offer wide scope for the design engineer to *design for welding.*

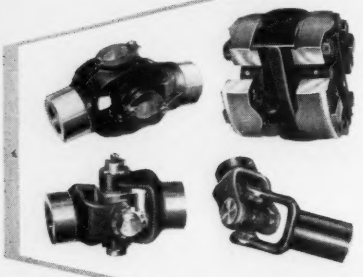
Contact any Liquid Air Branch for technical assistance on process and product applications in connection with your designing for welded fabrication.

Canadian LIQUID AIR Company
LIMITED

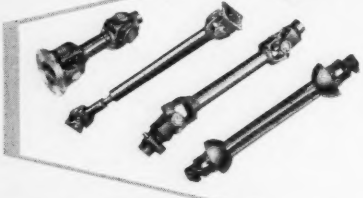
ST. JOHN'S, SYDNEY, HALIFAX, MONCTON, QUEBEC, SOREL, MONTREAL, CORNWALL, BROCKVILLE, TORONTO, HAMILTON, NIAGARA FALLS, WATERLOO, BRANTFORD, LONDON, SARNIA, WINDSOR, SUDBURY, COPPER CLIFF, ELLIOTT LAKE, PORT ARTHUR, WINNIPEG, REGINA, SASKATOON, EDMONTON, CALGARY, MEDICINE HAT, RED DEER, CRANBROOK, VANCOUVER, VICTORIA, KITIMAT, DAWSON CREEK.

BLOOD BROTHERS

offers universal joints and assemblies for almost any application



Sizes and types for heavy-duty automotive, construction and road building machines, farm implements, tractors and industrial machinery



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Here at Blood Brothers you can select from a wide, wide range of universal joints and complete drive assemblies. Torque capacities range from 350 to 500,000 inch lbs. — lengths from very close-coupled industrial joints to assemblies 120″ overall.

You can be confident they are produced in a modern, centrally located plant, tooled for precision manufacturing. And you can rely on their high reputation for dependability.

When you specify Blood Brothers, you can save valuable engineering time by stating your problem to our service-minded engineers. They're cooperative, friendly and long-experienced. Just write or call.

WRITE FOR BULLETIN 557 . . .
and for your convenience in specifying, request our free Blank Form "Specification Sheets".

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BLOOD BROTHERS MACHINE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
ALLEGAN, MICHIGAN

UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

New Products

Continued

Thermocouple probe

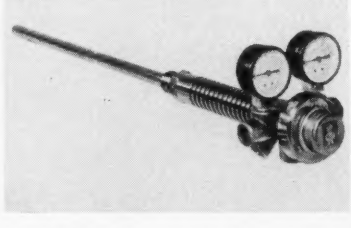
A high-temperature thermocouple probe for use in the high-velocity gas streams of jet engine afterburners and ramjet and rocket exhausts has been developed by **Thermo Electric (Canada) Ltd.** The unit was designed to solve the serious problems of probe life, accuracy, installation and maintenance at temperatures of 3600 F.

Key to its performance is the cermet (ceramic-metal combination) support tube and radiation shield. With such a shield, water or air cooling are eliminated and radiation losses to cold duct walls are reduced about 60%. Other disadvantages of water cooling (water supply, conduit, additional space needs and other installation difficulties) are also eliminated. Of equal importance are the conductors used in the probe. (225)

Solderless wiring

A revised catalogue on solderless wiring devices describes and illustrates new time-saving solderless terminals and connectors for crimping to wire extremities. Valuable data and sizes of various devices are included to facilitate selection for every wiring job requirement.

The catalogue is available from **Electrix Terminals & Connectors, Inc.** (226)

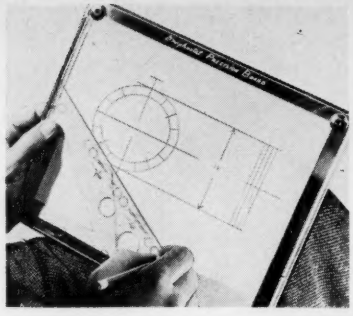


Pilot controller

A pilot type thermostatic controller for high-temperature applications has been developed by Fulton Sylphon division of **Robertshaw-Fulton Controls Company.**

The controller (model 1100C,D) is available in standard temperature ranges of 250 to 450 F and 350 to 550 F (or in any 200 deg range from 50 to 500 F). The controller, which is 3 13/16 in. wide and 19¾ in. long, is recommended where compressed air is used as the pilot supply.

The thermosensitive tube is made of stainless steel to withstand corrosion as well as temperature and erosion. A finned "thermal isolator" section keeps the pilot valve cool on high-temperature control applications. (227)



Portable drawing board

Molded of high-impact polystyrene, this precision board (by **Leslie Creations**) weighs less than eight oz. It comes complete with two transparent plastic triangles (30/60 and 45). Two retractable, metal straight edges eliminate the need for a T-square. Four recessed spring clips hold a standard 8½x11 in. sheet of paper, without thumb-tacks or scotch tape. The triangles clamp to the underside of the board when not in use. Rubber cushions protect the desk-top. The translucent board enables easy tracing, by holding against a window or other light source. The outfit measures 10x12 in., carries like a magazine and fits into briefcase. (228)

BTU meter

A completely mechanical instrument that measures heat and liquid-flow with high precision has been announced by **Air Conditioning Equipment Corporation.** Known as the Pollux BTU integrating meter, it can measure the heat absorbed by a liquid and the heat removed from the liquid. It can also measure the heating and cooling consumed in individual areas.

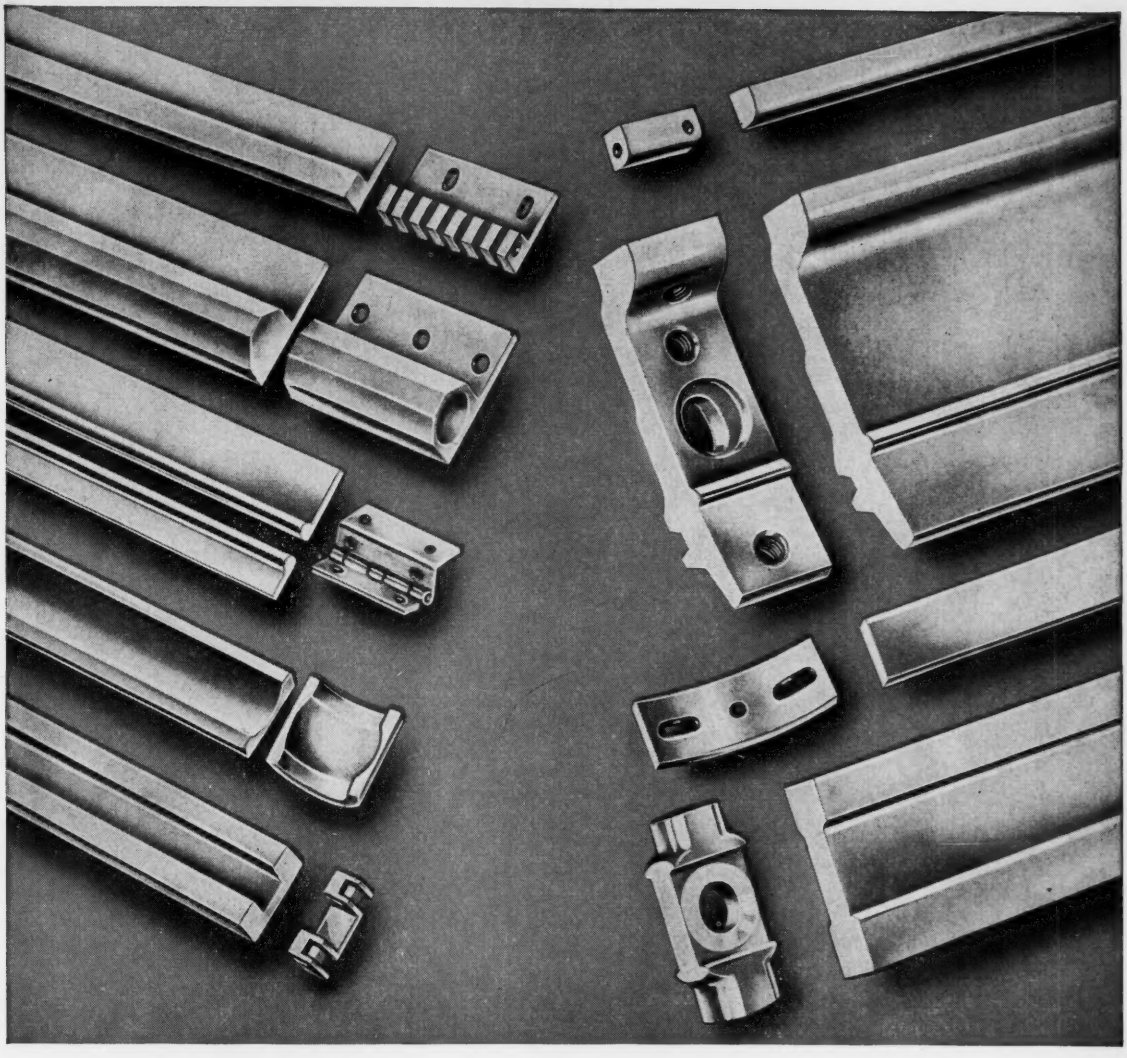
The meter has many applications. It can be used in the metering of central heating and refrigeration plants and is particularly suitable for measuring the quantity of heating and cooling consumed in individual areas of buildings. It is also suitable for use with liquids in industrial and chemical processes. (229)

Molding compounds

A full-color folder which points the way to new products, new uses and new markets through the use of Plaskon molding compounds has been prepared for designers, molders and manufacturers.

Products made of urea, melamine and alkyd molding compounds and nylon molding and extrusion compounds are listed and illustrated, and outstanding properties which make each molding compound ideal for these specific applications are briefly described. Designated P-95, the folder is offered by Barrett Division, **Allied Chemical and Dye.** (230)

A SHORT CUT TO A FINISHED PRODUCT



REDUCE YOUR MACHINING OPERATIONS, REDUCE SCRAP

get a superior wrought metal product with Anaconda extruded shapes

Cost-paring possibilities unlimited: In few areas can imagination and ingenuity pay off so handsomely as when applied to the use of extruded shapes. Visualize your finished parts as cross-sectional pieces cut from a long extruded shape.

Costs come down, quality goes up: Extruded metal is *wrought* metal—tough, dense-grained, smooth-surfaced, and easy to machine. When you switch from cast parts, you eliminate rejects due to pits and porosity; you reduce machining, scrap . . . and finishing time.

A manufacturer of hosiery knitting machines, for example, found he saved from 25-30% over cast brass. He makes 420 components from 12 different ANACONDA Extruded and Drawn Brass Shapes. He also gets the superior precision, balance, and long-wearing and bearing qualities in these parts, which must operate at high speeds.

Metals: Extruded shapes are available in copper, brass, bronze, and special copper alloys—in long mill lengths suitable for feeding into turret lathes or automatic screw machines.

Our experience at your service: The accumulated experience of this organization, its wide selection of dies, may help you shortcut production and save money.

We'll be glad to make suggestions based on your sketch or sample. Address: Anaconda American Brass Limited, New Toronto, Toronto 14, Ont. Sales Offices: Montreal and Vancouver.

C-5613

ANACONDA* EXTRUDED SHAPES

**Trade Mark Reg'd*

For high speed testing

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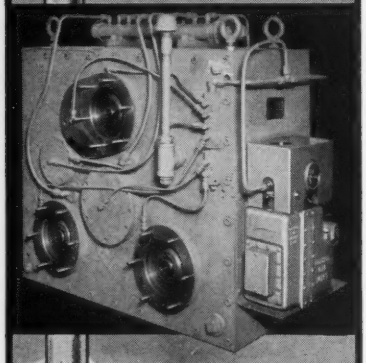
SPEED INCREASER UNITS



designed and built to your specifications

S-N SPEED INCREASER GEAR UNITS have wide application on aviation industrial test equipment. They are the product of transmission engineers with over half a century of experience. Standard units are available with a wide range of gear ratios and output speeds. S-N will also design and build units for special or unusual requirements.

Series 4070, illustrated, is used for fuel pump testing. It has a capacity of 400 HP at 1150 RPM. Each of the three output pads deliver the full rated horsepower. Two have output speeds of 4215 RPM, and the other 15,800 RPM. Complete information promptly furnished upon request.

SNOW-NABSTEDT
Transmission Engineers
FOR OVER HALF A CENTURY
THE SNOW-NABSTEDT GEAR CORP, HAMDEN, CONN.

Abstracts

Verticle volute pumps

The growth in size and capacity of steam turbines installed in central stations of utility companies during the last decade has brought about corresponding changes in surface condensers and in the auxiliaries serving those condensers. In particular, the larger condensing units being purchased require larger quantities of cooling water. In the U. S. the practice existed (with but few exceptions) of using vertical mixed flow pumps as circulators. The exceptions were generally in those installations where the use of cooling towers demanded a higher head than was possible with mixed flow pumps or where horizontal shaft circulating pumps were desired.

Realizing that the trend toward larger pumps would continue, and that slow speed drive motors would become larger and heavier (and thus more expensive in initial cost and in operation) Foster Wheeler undertook (about two years ago) to study alternative types of low head pumps and to develop a design better suited to the larger condensers. The investigation indicated that vertical volute pumps, with closed centrifugal impellers, have many advantages over mixed flow pumps and these advantages, combined with specific speed comparable to mixed flow pumps, made them, in many cases, superior to the mixed flow pumps.
(from Heat Engineering, May-June 1957, by Andre Kovats)

Pullshovels

It is a well-known fact that a large piece of earth-moving equipment in action has a certain fascination for the public, as is evidenced by the large numbers of the curious that usually gather around a construction site. The steam shovel has acquired in the public mind a sort of personality almost on a par with that of the steam locomotive. For the uninitiated, "steam shovel" has become synonymous with the correct names for a great variety of machines that look like steam shovels, but which in all probability are not operated by steam at all. The steam engine has been replaced by the diesel, gasoline or electric motor in excavating equipment and in the trade today the modern version of the old steam shovel is known as a power shovel. The type of power shovel widely used by the contractor today is the pullshovel. It, therefore, would seem timely to present a brief account on the subject of pullshovels. The various aspects dealt with are the history, design, application, operation and maintenance of this type of excavating equipment.

New magnesium alloys

In selecting metals for aircraft engines, missiles and airborne equipment, the trend toward extraordinarily high speed is emphasizing the matter of strength at high temperatures as an inseparable companion to strength at light weight. It is not surprising, therefore, that much work has been done on magnesium alloys to improve their properties. It so happened also that in 1948 the Atomic Energy Commission asked for such alloys which would have the additional property of low neutron capture. This combination of circumstances resurrected interest in the magnesium-thorium alloys, known since the late 1930's to have useful age-hardening capability.

The aim was to supplement the existing groups of magnesium alloys useful at respective temperature levels: (a) magnesium-aluminum-zinc for exposure to temperatures up to 300 F, as in reciprocating engines and (b) magnesium-misch metal-zirconium for temperatures up to 500 F, as in jet engines. The aim was to create alloys useful to 700 F for moderately long exposure.

This paper recounts very briefly the studies which indicate that magnesium alloys (with thorium as the principal alloying element) will meet this new demand.
(from Metal Progress, August 1957 by T. E. Leontis)

Seamless hollow parts

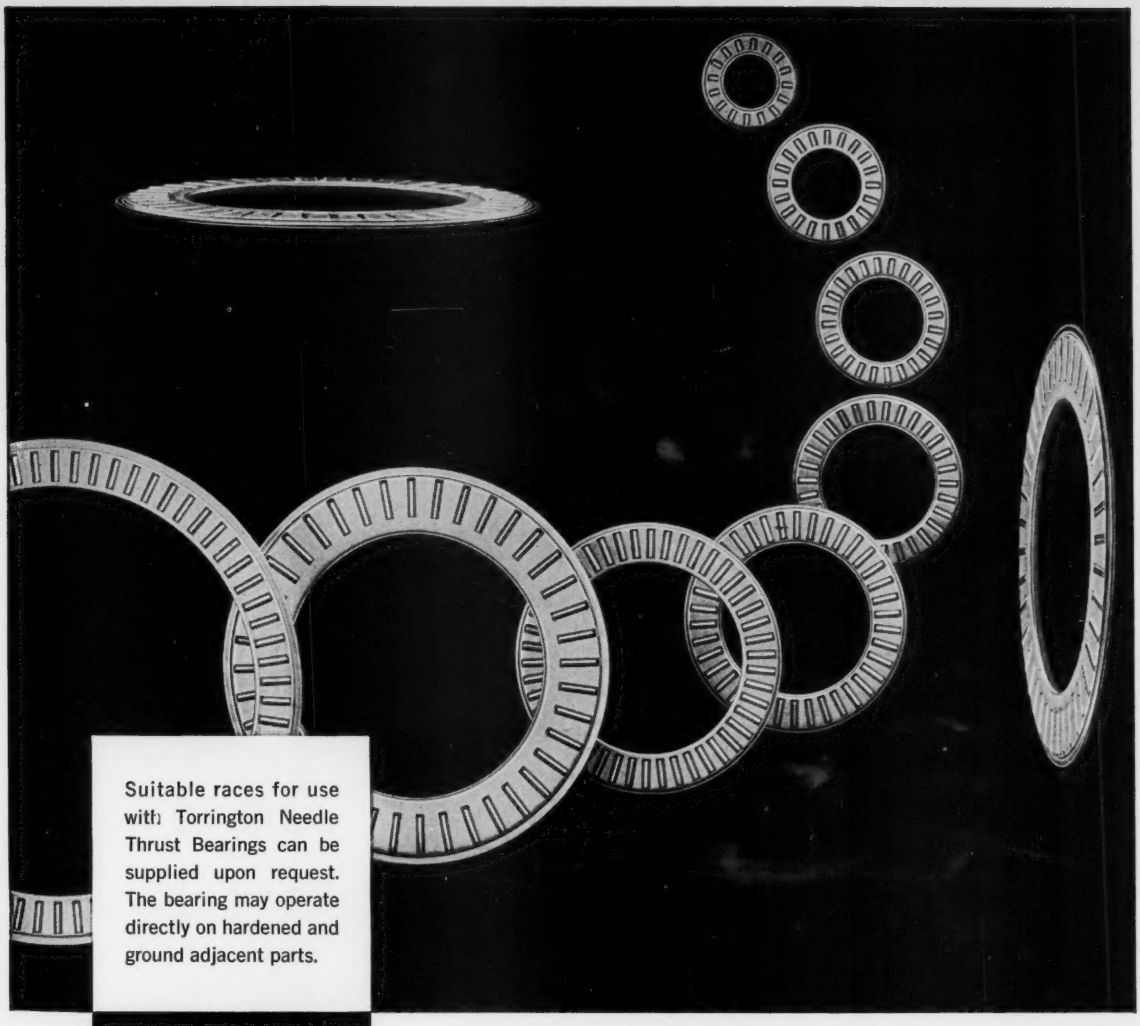
The Holofol process is a revolutionary manufacturing method used for producing seamless hollow articles from plastic material, cellulose derivatives or natural and synthetic rubber.

The process is based on the fact that foils or plates cut or stamped into shaped pieces may be processed into seamless hollow articles by a hardening of the surface (including the edges). This takes place from the outside toward the inside leaving, however, a thin unhardened corelayer.

This treatment is performed either by a physical or chemo-physical process, according to the desired finished article and the properties of the applied material.

After this treatment the core-zone (which still has its plastic character) is inflated by heating it in an infrared-zone, whereby a well-shaped seamless hollow body of high quality is brought about.

The process is specially adapted to the manufacture of fingerstalls, surgeon's gloves, sanitary and technical gloves, as well as inflatable toy animals.
(from SPE Journal, August 1947, by Walter Opavsky)



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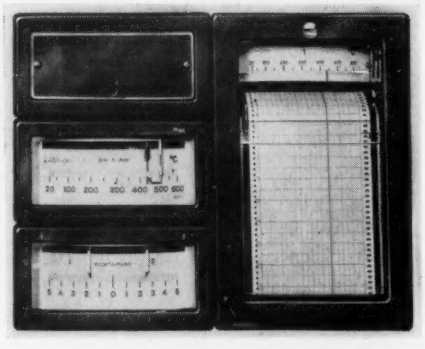

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Advertising Index — February

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Editorial

Society for engineering designers

We have just been reading a booklet sent to us by the Institution of Engineering Designers, a professional body in the U. K. on the same level (it is claimed) as the societies for civil, mechanical, structural and electrical engineers.

Their principal objects: to promote the general advancement of engineering design and to forward the practice and standardization of engineering draftsmanship; to raise the professional status of the more responsible engineering draftsmen and (particularly) engineering designers to a generally recognized standard.

Since so much design work (particularly the all-important detail design) is carried out by draftsmen, it seems to be a good idea for them to have a society of their own, particularly one that fosters the advancement of engineering design.

Important trends

Two points important to engineers appear in the Annual Report of the American Society of Mechanical Engineers:

(1) New efforts to streamline the techniques used for spreading information on engineering development. Typical is the introduction, at some meetings, of the reporter-system, wherein technical papers are distributed in printed form and a summary given by a trained reader (or reporter).

This is an excellent idea. It will cut out a lot of the monotonous droning so often encountered at technical sessions and will consequently leave more time for the discussion period, surely the most worthwhile part of any meeting.

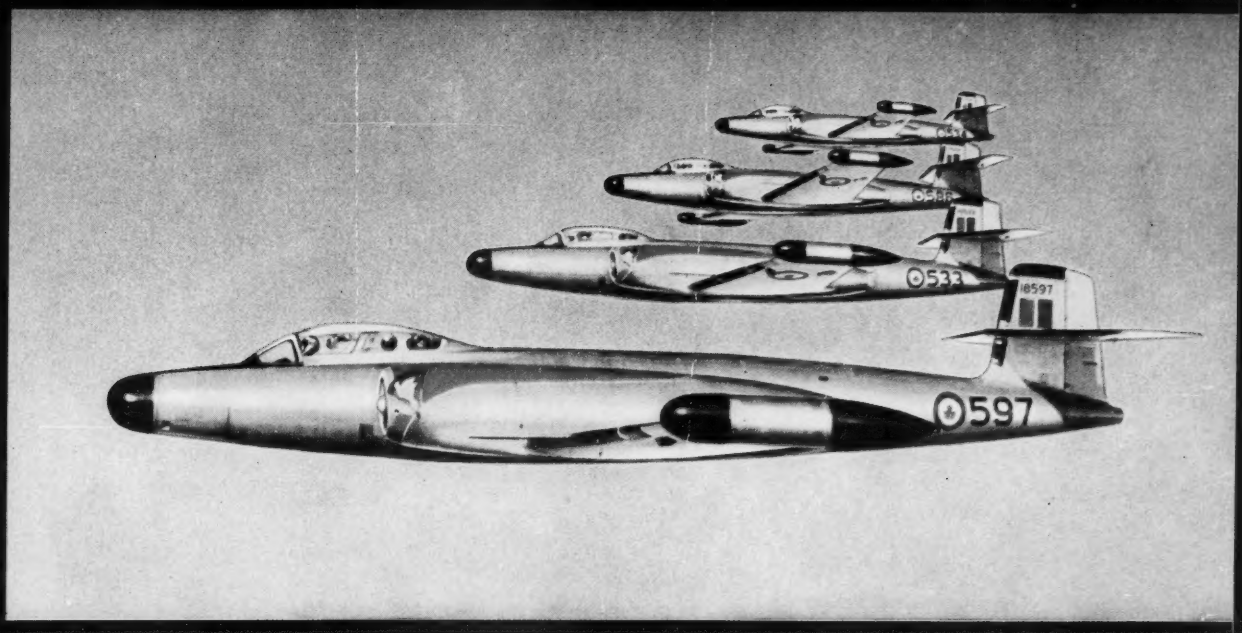
(2) A trend towards more meetings jointly sponsored with other technical groups, particularly in the fields of lubrication, management, mining and chemistry. This makes it possible for technical programs to be more comprehensive than would otherwise be possible, with a smaller expenditure of time and money.

Big ASM meeting

February 7 is to be a big night for the Ontario Chapter of the American Society for Metals. G. M. Young (of the Aluminum Company of Canada and the first Canadian to be appointed National President of the ASM) will be the principal speaker before an audience of presidents from many Canadian companies engaged in the metalworking industry. Of the 130 presidents invited, over 60 have so far accepted the invitation.

William Morse.

FOR SERVICE WITH THE BELGIAN AIR FORCE



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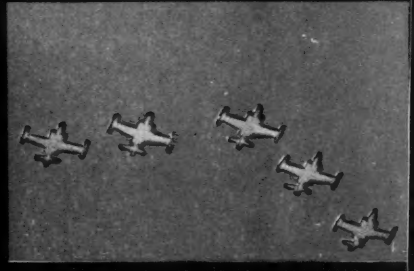

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The first squadron of Avro CF-100 Mark 5 aircraft for the Belgian Air Force has been delivered for operational service.

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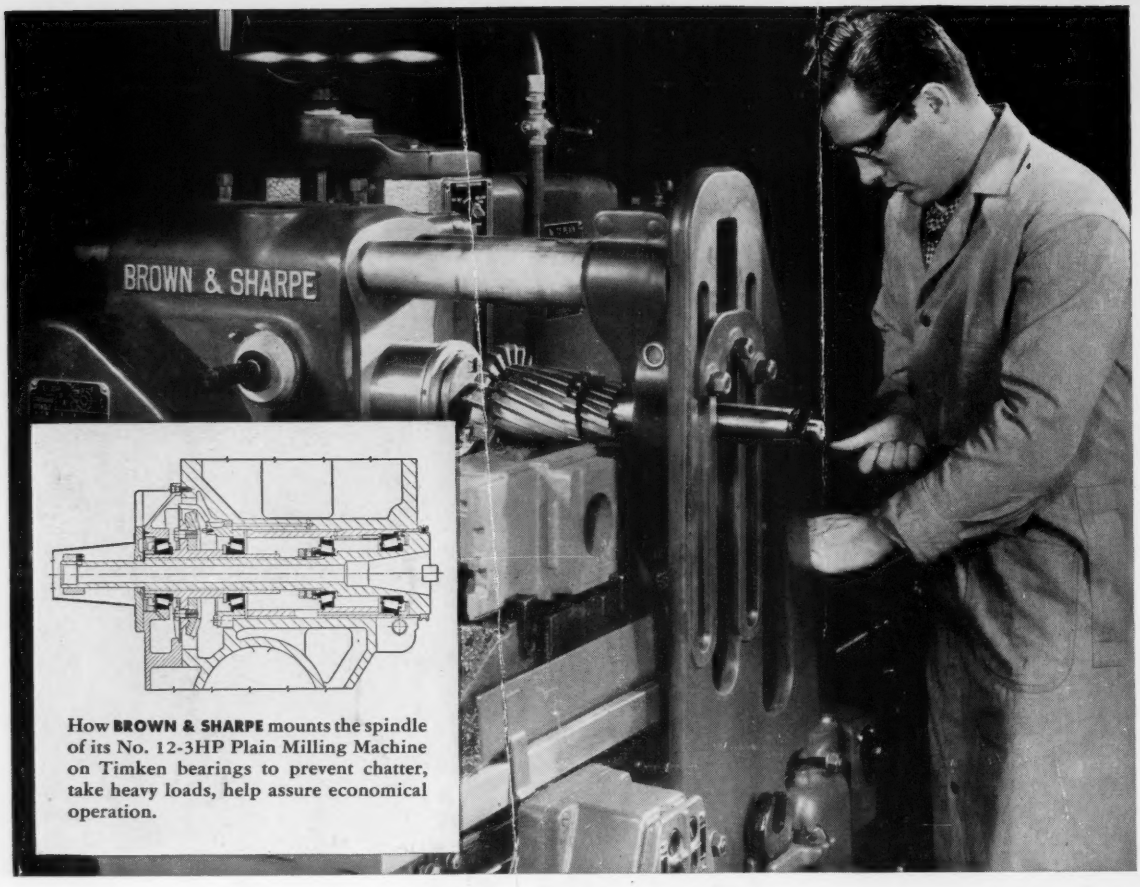

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Timken bearings hold the spindle in positive alignment. Their tapered design lets them take *both* radial and thrust loads in any combination. And full line contact between rollers and races gives Timken bearings extra load-carrying capacity.

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Rollers and races on Timken bearings are case-carburized to have a hard, wear-resistant surface over a tough, shock-resistant core. They take heavy loads and come back for more.

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Timken bearings are geometrically designed to have true rolling motion and are precision-made to live up to their design. Practically friction-free, they last longer and run smoother. And to assure complete quality control, we even make our own electric furnace fine alloy steel. So for your No. 1 bearing value, always specify bearings trade-marked "TIMKEN". The Timken Roller Bearing Company, Canton 6, Ohio, U. S. A. **CANADIAN PLANT:** St. Thomas, Ontario. Cable address: "TIMROSCO".

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